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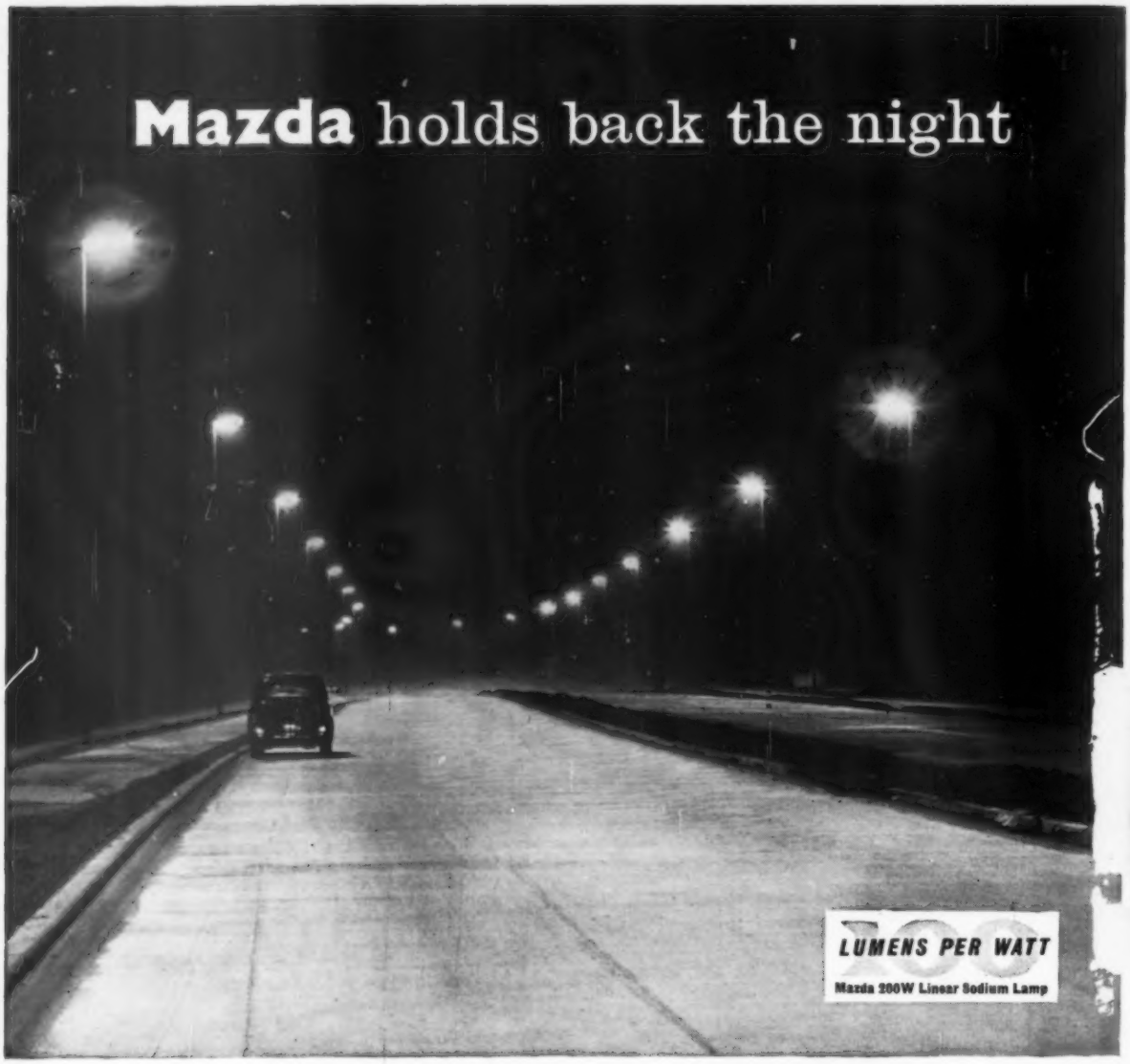
Tremola Glen, on the reconstructed St. Gotthard Pass.

See Switzerland's 20-year Road Programme—Page 199



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VOLUME 2 No. 4 AUGUST 1960

The only British monthly devoted exclusively to traffic engineering.

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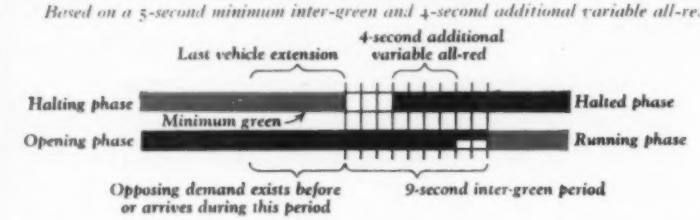

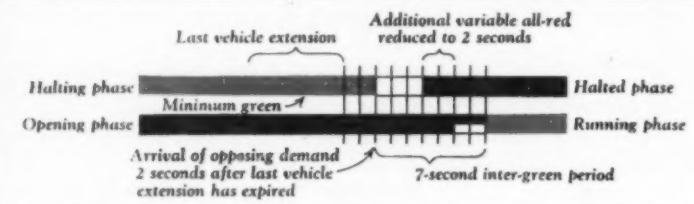

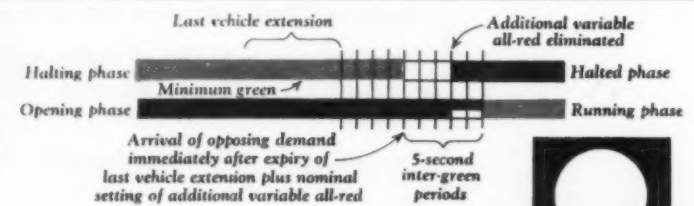

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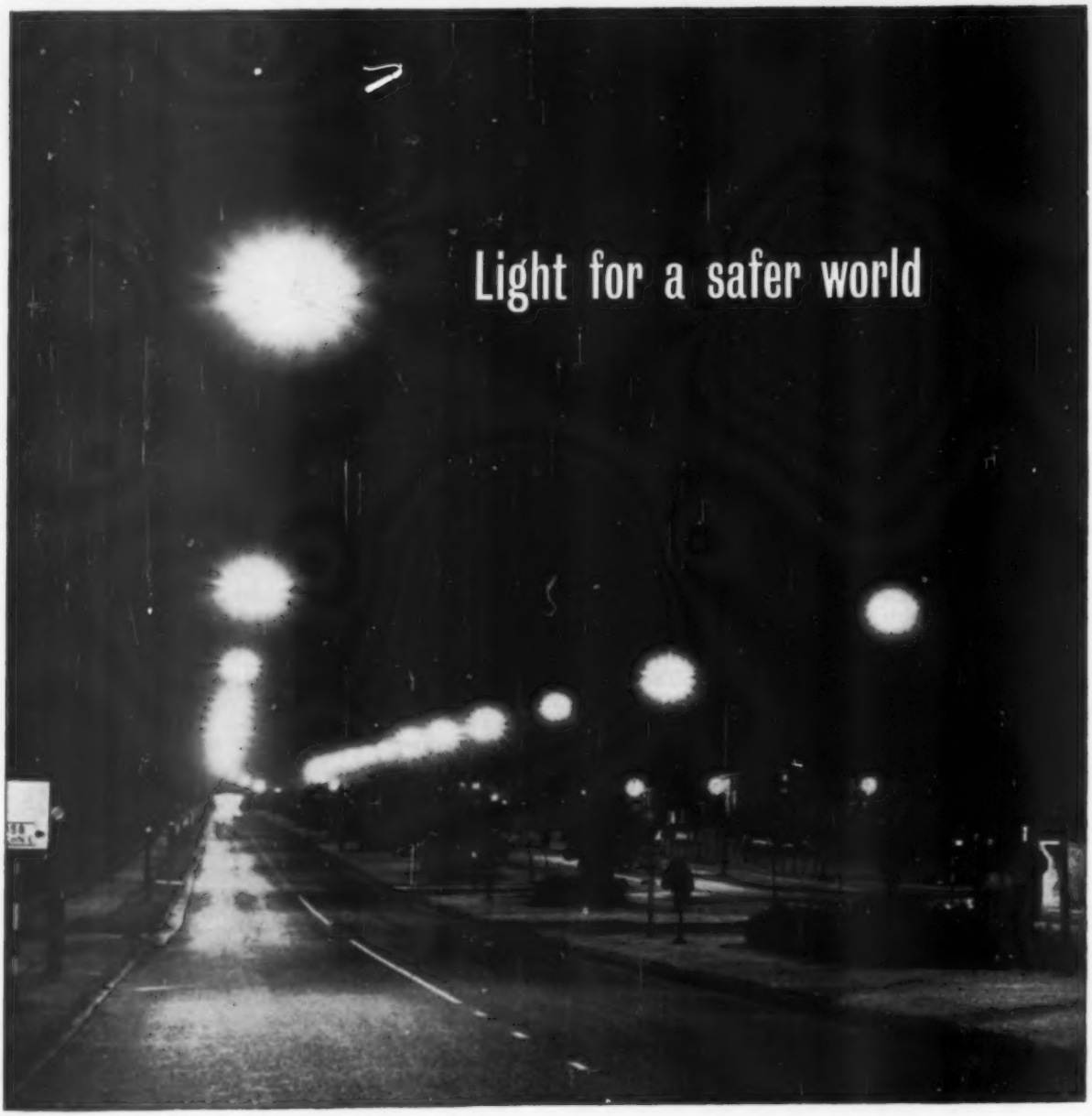
Need for New Road Standards

WHEN visiting the Ross Spur Motorway, the Minister of Transport implied that the 24-foot carriageways were inadequate for modern traffic volumes and, that if the lessons learnt from the Birmingham Motorway had been available when it was planned, wider carriageways would have been specified. Since Mr. Ernest Marples later retracted, and the Ministry denied he had said any such thing, or anyway had not meant what he said, perhaps it is permissible to suggest that he was speaking on the spur of the moment. There is no doubt that Mr. Marples would have been right if he had made the statement attributed to him, because there is every indication that traffic is growing even faster than predicted, and these new roads attract and generate traffic. But whether he was correctly reported or not is of less importance than the revelation—which was only the confirmation of a suspicion—that no firm standards for motorways have been laid down by the Ministry, nor for that matter has there been any recent revision of those for all-purpose or urban roads. Once more, in regard to road planning, Britain is dragging her feet, or, in more appropriate idiom, braking her wheels.

Last month we published the Belgian standards decided upon for the next twenty years, and this month we do the same for Switzerland. In both cases, extensive traffic studies, to assess probable traffic demands during the next two decades, preceded the fixing of both the standards and drawing up of the roads programme, and, in both countries, the programmes are being carried out in accordance with these standards. It is hardly necessary to add that proportionate to national resources each of these countries is spending far more in executing them, and far more speedily, than is contemplated in this country at the present time.

It may be that as regards techniques of construction, this country's civil and highway engineers have no superior, but, in regards to standards and design, the Ministry does not avail itself adequately of their know-how, nor for that matter make full use of the equipment available. The least that can be done is to determine the standards necessary to enable us to live tolerably conveniently with the motor car, even if we cannot immediately carry out a sufficiently large programme of road construction and improvement to enable us to do so in comfort. Evidence is plentiful of the need for such standards and of an awareness of what they should be. For instance, immediately the Birmingham Motorway was opened it was apparent that its eight-foot hard shoulders were quite inadequate to meet the needs of modern vehicles compelled to draw off the carriageways in emergency, but even before it was officially opened to traffic the Road Research Laboratory had experimented with lorries on different widths and had found that with an eight-foot shoulder the driver of a lorry parked on the hard shoulder would have to descend on to the carriageway to leave his cab, and even with a ten-foot shoulder he would do the same, or at best step on to the white edge marking and protrude into the carriageway. Only with a twelve-foot shoulder would his safety be assured; but no such standards for new motorways have so far as is known, been laid down. The results of this experiment are published in a later page.

If there were any lack of information as to the inadequacies of our roads, that gap has now been filled. The Road Research Laboratory recently completed a sample survey of the country's roads from which has been built up an inventory, as it were, of the characteristics of the whole network, and the results reveal an overall appalling deficiency in standards of design, quite out of line with the requirements of modern traffic and road safety. Unfortunately, the results are not yet available for publication, but at least they are in the hands of the Ministry, and should act as a stimulus to the Minister, and give him invaluable ammunition for use in the running fight which it is to be hoped he is continuously carrying on with the Treasury for increased allocations for road construction and improvement. At least it should prevent the roads programme from the freeze in public expenditure which the Chancellor of the Exchequer has demanded, and which would be inexcusable economic idiocy to apply to the roads. Whatever the outcome of the successive rounds, the Minister's immediate task is clear. Pending a sufficiency of funds for an expanded programme, he should follow the example of other countries, often smaller and economically less favoured than ours, and order a nationwide assessment of probable traffic needs over the next twenty years, and the drafting of a programme ample to requirements. Even if, as is inevitable in view of our present inadequacies, such a programme cannot be carried through as fast as the need demands, at least it would enable one to be planned and phased so that all construction could be in accordance with it, instead of so much being piecemeal and by hunch, and it could be accelerated as resources became available.



With road safety a major consideration, this ¾-mile stretch on the main Glasgow-Edinburgh road is now lit by 52 high wattage Sodium lamps developed by Philips Electrical Ltd. The new system was largely the inspiration of Mr. Denis Colvin, Street Lighting Engineer to the County of Lanark, who co-ordinated the activities of Philips on lamps and gear, the Engineering & Lighting Equipment Co. Ltd. in their development of the new ELECO Golden Ray '280', and of Messrs. Stewarts and Lloyds, who provided the special steel columns. In operation it is no longer possible for confusion of light sources to be an accident hazard and the reduction of the number of columns used reduces the number of possible collision points.

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Topics of the Month . . .

Road Safety Research

ESTABLISHMENT of an international centre for the co-ordination and exchange of research into road safety was the satisfactory outcome of the international meeting of experts from thirteen countries, held in July at the Road Research Laboratory, under the Chairmanship of Sir William Glanville, and sponsored by the European Productivity Agency of O.E.E.C. Steps were taken to prepare for the setting up of an international body responsible for co-ordinating the research effort of the countries concerned; to foster the interchange of road research information and to recommend new research on problems, the solution of which requires, or would profit from, international co-operation. Although as much research into factors affecting road safety is probably being undertaken by the Traffic and Safety Division of the Road Research Laboratory as by any other research organization, hitherto, on occasion, it has been found that those working on the same problems, or carrying out similar investigations, are unaware of each other's findings. A clearing house for the exchange of information should, therefore, eliminate overlapping and ensure that optimum use is made of research laboratories and their workers. This purpose can also be served if there is a division of labour by the allocation of research projects as between the different countries, always provided there is complete sharing of progress and findings. All countries with a high degree of motorization are suffering from a growing number of road accidents and the accompanying casualties, and all employ various means in an attempt to reduce the danger of the roads. Much, however, is guesswork, and more research is necessary into causes, both as regards road design and of human behaviour. The pooling of experience, and the co-ordination of effort, is therefore desirable and should assist the Road Research Laboratory to extend its activities in this field and add to their value. The best encouragement that could be given, however, would be for the Government to increase the totally inadequate funds the Laboratory is at present able to allocate for this work.

M.P.'s and Traffic Engineering

THE twenty Members of Parliament drawn from the All-Party Road Study Group who, under the auspices of the Roads Campaign Council, recently visited Stockholm, Mannheim and Ludwigshaven to see how urban road construction and the control of traffic can be planned in accordance with traffic needs, returned as much impressed with the completed works seen as with the planning that preceded their construction. Stockholm's plan for the solution of its traffic problem goes back to before the War when it was originally planned by Dr. Feuchtinger and appeared revolutionary, but he was as foresighted as were the City Fathers of Stockholm who, over the years, acquired land to make it possible to carry out the reconstruction of the roads and traffic network. This enabled the cost to be kept down and comprehensive development to be associated with it. In fact, acquisition costs have totalled only about 10 per cent of expenditure against 90 per cent for construction. In London the figures can easily be the other way round as is being so unhappily illustrated with the high cost and private ownership of land preventing urban renewal on the grand scale. Apart from the question of land ownership, however, the M.P.'s were impressed with the integration of town planning with road construction and urban development, and the fact that roads and traffic planning were in accordance with schemes drawn after comprehensive studies of traffic needs.

Mannheim, a town no larger than Nottingham, employs a dozen traffic engineers and is not afraid to call in outside consultants when large-scale plans are being made. Consequently, reconstruction of the roads and traffic networks of this city, including the multi-level and multi-purpose Rhine Bridge, illustrated elsewhere in this journal, was only proceeded with after intensive traffic studies, and was designed to enable the fulfilment of the latest traffic engineering techniques in regard to road design and traffic circulation. But only now has the Minister of Transport at long last authorized a comprehensive traffic study to be made for the whole of London. This belated recognition that the road construction and the relief of traffic congestion must be based on data, scientifically collated and intelligently assessed, is to be welcomed and the Minister's action it is to be hoped will be emulated by those authorities who have traffic congestion to contend with and who have not yet undertaken traffic studies to enable long-term programmes to be drawn in conjunction with development plans.

Dr. Feuchtinger

THE death of Dr. Max-Erich Feuchtinger in Ulm on June 30, following an abdominal operation, at the comparatively early age of 50, is a sad loss to traffic engineering of which he was a pioneer, teacher and practitioner. He rightly enjoyed an international reputation and had been called into consultation by many a city authority who had hitherto found its traffic problem intractable.

Although the plans recommended by Dr. Feuchtinger varied according to the pattern of the town concerned, he followed the same technique in tackling the problem. Comprehensive studies, to ascertain the pattern and behaviour of traffic and its needs, were followed by projection to its future development, and finally, after an economic assessment of alternatives, the planning of the roads network to meet it. This collation and analysis of traffic data was not his invention, but he reduced it to this simple formula that had a universal application. Further, Dr. Feuchtinger was always conscious of the need to preserve the character and social and economic life of the towns he was called in to treat and it was here perhaps that he made his greatest contribution.

Dr. Feuchtinger will be sadly missed, but it is very gratifying that he made no monopoly of his ideas and since 1957 he in effect established his own school of traffic engineers. Also, as both Professor of Street Construction and Traffic at Stuttgart Technical University and as a Traffic Engineering Consultant, he conveyed his methods and techniques to others who remain to carry them out, whereas towns whose roads and traffic network he replanned will remain as his best memorial.

The Traffic Octopus

LONDON'S ANSWER

by Richard Edmonds

L.C.C.—Chairman, Town Planning Committee

Fig. 1. The Elephant and Castle—an important new urban intersection with municipal housing, a shopping centre and the London School of Printing (in background) grouped round the figure-of-eight road pattern.

THE Roads Campaign Council's international competition 'New Ways for London' produced the much heralded winning entry of J. A. Proudlove, bearing the simple unsensational title 'A Traffic Plan for London', but containing within it, I would submit, elements that make for the disruption of the metropolis as we know it today, a complete change in its character.

Perhaps it is well, at this point of time, when motorways are approaching the built-up areas of our historic cities, when congestion within the cities is disruptive both of business and social life, that this matter should have been brought out into the open, and that as citizens we should make our decision as to what sort of London, what sort of provincial cities, we want to see. It is as simple as that, and the Roads Campaign Council has surely done a service by highlighting the question, and Mr. Proudlove has done a service also by so ably stating the case for 'living with the motor vehicle' or, to put it more frankly, for allowing it to dominate our lives.

Where I join issue with the Roads Campaign Council is in the way they have progressively presented their case, progressing from the reasonable to what I deem to be the unacceptable. In my submission, the Council has not been forthright about the matter; in a word we have been beguiled.

Let us first of all go back to the report on the five award-winning traffic plans for London. Here Sir William Holford, now the new President of the R.I.B.A., was permitted to take the stage, and his foreword to that report was a most reasonable document showing the many and various reasons motivating the New Ways for London competition launched at the end of 1958. Let me quote those most reasonable reasons:

> The first was to invite expert appraisal by engineers, architects, and town planners of some of the ideas proposed in words, but not yet worked out in three dimensions, for solving the rapidly increasing problem of traffic congestion in London.
>
> The second motive was to show the authorities concerned with highway construction that there is potential talent in Great Britain equal to the problem and able to provide solutions comparable with those used in other parts of the western world, yet specially adapted to the scale and character of London and other British cities.
>
> The third, and extremely important reason, was to awaken in the public's mind, through the Press, the knowledge that the urban motorway, the traffic-free pedestrian precinct and walkway and the multi-storey garage are vital features of cities if these are to be used efficiently. To prevent friction, waste, and eventually chaos, a rational design is needed for living in the mid-twentieth century; and modern methods of circulation can lengthen the lives of our historic communities.

All this is, of course, superb, but it is the voice of Sir William Holford, perhaps the greatest town planner of our time, a man of humanity, breadth of vision and intellect. It is not the stark utterance of the road engineer, ready to do battle with all his colleagues and to fight every inch of the way for a new highway system on American lines. We have to wait for that; but in due time it comes, all put succinctly and forcefully in the opening two pages of the Proudlove report, the winning entry. At this stage we do away with most of the architectural cum planning fripperies and fineries. We get down to basic engineering facts.

Competitors, we are told, were faced with an estimate of future traffic volumes, and, by implication, they were faced from the outset with the very dangerous assumption that the economics and the facilities of public transport would be allowed to worsen, and that the number of vehicles entering the central areas of London each day (now estimated at 70,000) would be permitted to increase very considerably. The Roads Campaign Council had indicated that the suggested design hour volumes for the area under consideration would show volumes of about treble the 1954 figures. Thus armed, Mr. Proudlove and his colleagues had evidently got to work, thinking in terms of a new road system which would deliver about 43,000 vehicles an hour into

central London on top of the 23,000 vehicles delivered by the existing ordinary road system.

Thus, from the outset, Mr. Proudlove and his friends were working on a policy of abdication in regard to the public transport system. They were saying in so many words that it was doomed to failure; it was going down the slippery slope, and the only thing left to do was to get on with new, better and bigger roads. Here they were, these forward-looking engineers, admitting failure on the public transport front at a time when well over 90 per cent of the daily inflow of business people to London was carried by that system, when but a small percentage were using the roads and many of those were commuters who could surely be urged to better ways in a more reasonable overall pattern of metropolitan traffic. This is meant to be no condemnation of Mr. Proudlove's winning entry. Beyond all doubt his is an overground traffic solution stemming from deep thought, and much experience; but I do submit that it is based on false theorizing, and it is not rooted in either the political wishes or the social demands of the people. Its cost is enormous, probably beyond all Treasury thinking now or in the immediate future, and if only a tithe of it was spent on the public transport system it would surely be well spent indeed!

What then do the people of London and of English cities demand in respect of their road system? Do they completely reject, for instance, the American point of view on this issue, or indeed the point of view of many of our own business men, that this is the age of the motor car and that we must live with it.

Let us take, for instance, the extreme example of living with the motor car. I refer to the city of Los Angeles, a city prone to earthquakes and denied the advantages of an underground railway system, a city where over 90 per cent of the people come in each day by car and less than ten per cent by public transport (almost the exact reverse of London). The Los Angeles solution, magnificent though their freeways may be, would never be acceptable in England. The very thought that a road interchange system should occupy 100 acres of urban land is surely anathema to us all?

Let us then examine a more moderate example, New York. One cannot deny admiration for the New York solution, with great highways carrying the traffic through the boroughs by way of a network of tunnels and bridges into the heart of Manhattan; but does not the sheer dominance of the motor car create in New York a way of life we simply cannot understand or tolerate?

Only recently I spent a night at the International Hotel at Idlewild. Seeking to recapture the memories

Fig. 2. Above, Richard Edmonds, L.C.C., and Hubert Bennett, Architect to the Council, with the model of the Hyde Park Scheme, and Fig. 3 below, a model of the Marble Arch scheme, showing the new four-acre open space which will stand at the end of London's processional way stretching from Buckingham Palace through Hyde Park Corner.

of earlier days in Gotham, I asked the porter at the hotel how I might walk to Lefferts Boulevard to catch the subway in to Broadway. He courteously enough replied that folk did not walk round these parts, they simply took a car or a taxi. Anyway there were no sidewalks, he concluded. He was right enough on the last point, and so a disgruntled traveller had to make his way to the subway by taking courage, hopping across the central strip in the roadway, and making the best of a bad job. I could not help but admire how Barbara Moore had legged it across America if these were the sort of conditions she had to encounter.

A few days after leaving New York I had the opportunity of studying road conditions in the American commonwealth of Puerto Rico. There, too, affairs were much the same; it was, in fact, a poor lookout for the pedestrian. Modern San Juan, the up and coming capital of Puerto Rico, seemed to me to be a wilderness of concrete roads cutting like knives through the heart of the community. Old San Juan, Spanish in thought and appearance, had all the charm of a city unaffected by the modern madness for the motor vehicle.

Let us return to the question, what do the people of London and the English cities demand? I think the answer is to be found in one word, and that one word is *reasonability*.

Back in the summer of 1959, admittedly when most folk were on holiday and had other things to think about, the Committee on London Roads published its report, and it was laid before Parliament. This report, jointly presented by representatives of the Ministry of Transport and of the London County Council, the work of a hybrid committee of civil servants and elected representatives, was mainly concerned with considering a £120 million twenty-year programme for London roads, one based on the Development Plan approved by the Minister of Housing in 1955, and a £200 million twenty-year programme, giving a more generous level of annual expenditure, but not beyond the scope either of government or local government. Those deeply concerned with highway matters might say that neither the programme at £120 million nor the programme at £200 million could make any real

contribution to the traffic problems of London, that this was a mere nothing compared with the true needs, a very modest affair compared with Mr. Proudlove's winning entry in the New Ways for London competition, or the detailed study prepared by the Association of Metropolitan Borough Engineers and Surveyors, or for that matter the British Road Federation's elaborate and expensive Ring Road scheme. It could be said that this expedient of adapting the programme to the probable expenditure, the sort of allocation the Treasury would allow the Ministry of Transport, was quite the wrong sort of approach. What was truly needed was an expenditure related to traffic need. That, of course, is the matter that we have to decide. As I see it, the Nugent Report, to give its colloquial title and which honours the name of a more than ordinarily distinguished erstwhile Parliamentary Secretary, makes a well balanced and mature approach to the problem of our urban roads.

Since the day when it was so unobstrusively introduced, and so modestly escaped the major headlines, the Nugent Report has more and more come to be read and respected, its true contents known, and its purposes understood. Let us examine some of the objectives of the report, and they are very far from dealing only with traffic need. As I see it, they deal essentially with the needs of the town and the town dweller.

The first conclusion was that roadworks should proceed at the rate set out in the development plan (i.e., the £120 million programme), with special emphasis on intersections where most delays occur and emphasis too on the dock and industrial traffic, encouraging the latter to avoid the overloaded central areas. Regard was paid to linking effectively with the incoming motorway system, and it was evident from the report that in this connection there was to be emphasis on the Inner Circular Road, a link between Western Avenue and Eastern Avenue, running right across north London along the line of the Marylebone Road, and keeping a great weight of traffic out of the heart of the central areas. This road, coming over the railway tracks at Westway and hugging the railway through North Kensington to Paddington station, would be a fine example of a modern road, taking advantage of the pattern created by the railway age and avoiding the heart of the west London neighbourhoods. Copenhagen is contemplating something along the same lines; and for the same good reasons.

Fig. 4. above, the Cromwell Road extension. Talgarth Road seen from the south side. The opportunity for landscaping on the north side is obvious, and Fig. 5. below, the houses on the north side of Talgarth Road removed. The architectural sweep of the road in its new form will be readily appreciated.

Similar thought was given in the report to the West Cross Route which could link up with the South Circular by way of a new bridge across the Thames in the Lots Road area of Chelsea, and would also have the advantage of following the railways and avoiding neighbourhoods. These ideas, while imaginative from a traffic point of view, were clearly aimed at the same time at preserving the pattern of community life in London.

The next major theme of the report was that a car parking programme was essentially part of the road programme, that clearing the streets of the central areas was as vital as widening those streets, and even easier of achievement if tackled in the right way. The report urged a network of metering schemes for the central area, allied to a pattern of off-street car parking provision (with some government assistance, said the L.C.C., to buy the more expensive sites), and, to complete the three-pronged attack, it called for police enforcement to clear the Queen's Highway.

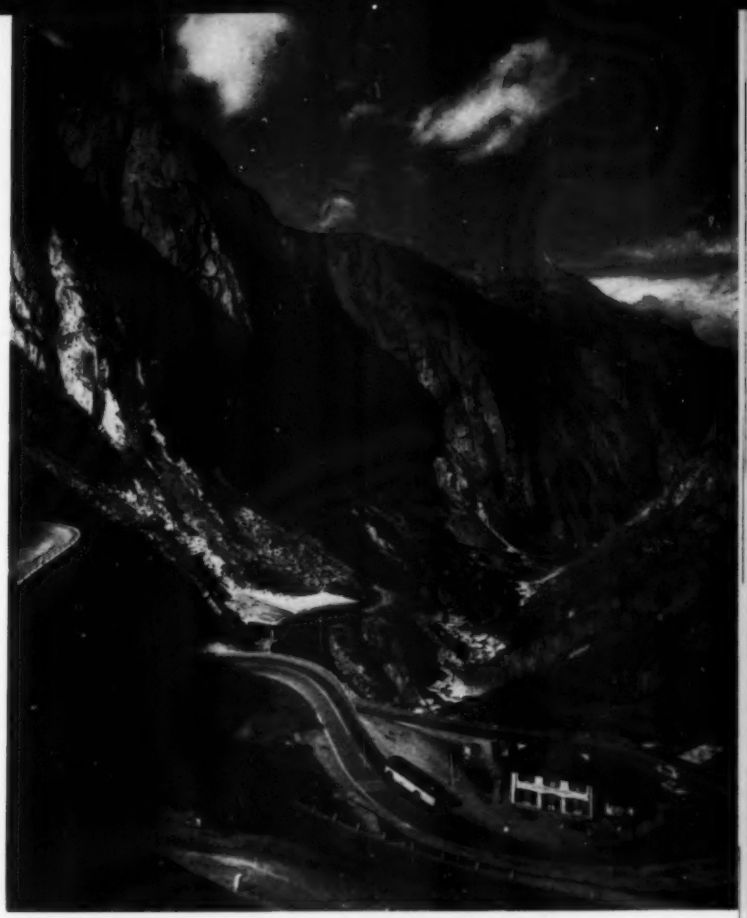
With these types of improvements in mind, it was clear that as many as 100,000 cars might enter the central area each day, and at the same time they would be provided with adequate terminal facilities, not only in the metered parks and the off-street car parks, but within the curtilage of new buildings where new parking spaces are being provided at the rate of 3,000 or 4,000 a year. What the framers of the report did not contemplate was that many more than 100,000 cars a day should enter the central area. In their minds, clearly, was the preservation of the present percentage of users of public transport to users of private transport, and a strong hint was given, though outside the Committees' terms of reference, that projects like the Victoria Line would be of immense benefit to the travelling public. My

(*Concluded on page* 204)

SWITZERLAND'S 20-YEAR ROAD PROGRAMME

by M. de Bussy

The Swiss National Road Plan drawn up late last year covers the period to 1980. In this article, the author, recently Director of Roads at the Rijkswaterstaat, at The Hague, describes the traffic studies on which it was based and the design standards recommended.



The new St. Gotthard Pass. Hairpin bends at Schollenen Gorge.

NOTWITHSTANDING its fairly high degree of motorization and the importance of tourist traffic, Switzerland has, as yet, done little for the benefit of its road traffic. In general, the autonomous cantons only have improved sections of existing roads, although south of Lucerne is a short stretch of motorway. But the report of the Commission appointed in 1954 to study the road traffic problems and to advise on a national road plan is most comprehensive and thorough, consisting of six splendidly executed volumes of 100 to 200 pages each, with a wealth of tables, graphs and maps.

Switzerland can be divided into two parts. The undulating and hilly area north of the Alps, with its dense population, industry and commerce, stretches from Geneva in the west to the Bodensee in the east over a length of some 170 miles, while its width is nowhere more than 35 miles. It occupies considerably less than half of the national territory. South of this area are the high mountains with a very low density of population, except in a few penetrating valleys (of the Rhine, the Rhone and the Aar) and in the region of Lugano and Locarno, and here the main tourist resorts are to be found.

The road problem follows this division, the northern area presenting the same requirements and possibilities as most western densely populated countries (dense, economically important traffic, with the possibility of constructing roads of normal standards) whereas the Alps do not permit, nor require, the building of high speed roads.

The traffic problems in the Alps are discussed separately in the fifth volume of the report. The other volumes refer to: general matters, project of a motorway system in general, projects in detail of motorways, urban express roads to connect motorways (not yet published), programme costs and financing and legal procedure. From the data and opinions given the following may be cited.

According to an investigation in 1956 concerning approximately 13,000 vehicles, small cars averaged 11,500 miles a year and heavy cars and lorries 13,000 miles each. An estimate shows that in the same year 2,000 million Swiss francs (£170 million) were spent on vehicles, fuel, repairs, etc., which was 8 per cent of the national income. 1,037 persons were killed in traffic accidents, which is equivalent to 0.19 killed to one million vehicle-kilometres, whereas the same relation is only 0.08 on German motorways. In 1957, Switzerland's 5,117,000 inhabitants had cars at 81.2 per 1,000 inhabitants, 415,000 in total. But 2,458,000 foreign automobiles entered the country in the same year. This explains partly the very high percentage of light vehicles (cars and light vans) on the roads; an average of from 88 per cent and rising to 95 per cent on alpine roads in summer.

A general traffic census as part of an all-European census in 1955 is the main source for traffic analyses. But on six primary roads automatic counters give the traffic density continuously hour by hour. On the alpine passes separate counts determined the Swiss cantons or the countries of origin of traffic.

Cordon censuses around 17 cities, and investigations in five cities provided detailed information on urban traffic, and tables and graphs give traffic distributions throughout the year, week and day. In accordance with American data the 30th hour traffic in Switzerland is two-thirds to four-fifths of the absolute maximum. The relation between the highest hourly volume and the daily average on roads was found to be: 0.203 for entrances to cities; 0.225 for rural roads with mostly business traffic; 0.261 for rural roads with important tourist traffic, and 0.414 for alpine roads with preponderant tourist traffic.

Graphs give lengths of trips of vehicles leaving Basle and for the relation between the distances to various cantons and countries, and the number of vehicles originating from them observed on the alpine passes. Roughly, a hyperbolic curve can be drawn through the diagrams, but the points are rather widely scattered. In general, it can be said that the main currents of business traffic follow a direction south-west to north-east in the oblong densely populated part of the country north of the Alps. Perpendicular to this direction are the streams of tourist and recreational traffic.

Predictions of future traffic are based on an extrapolation of the curve of the number of vehicles with a gradual decrease of the rate of growth: from 1960 to 1980 the number of automobiles is supposed to increase from approximately 500,000 to 800,000. In the same time the population will only rise from 5.3 to 5.5 million.

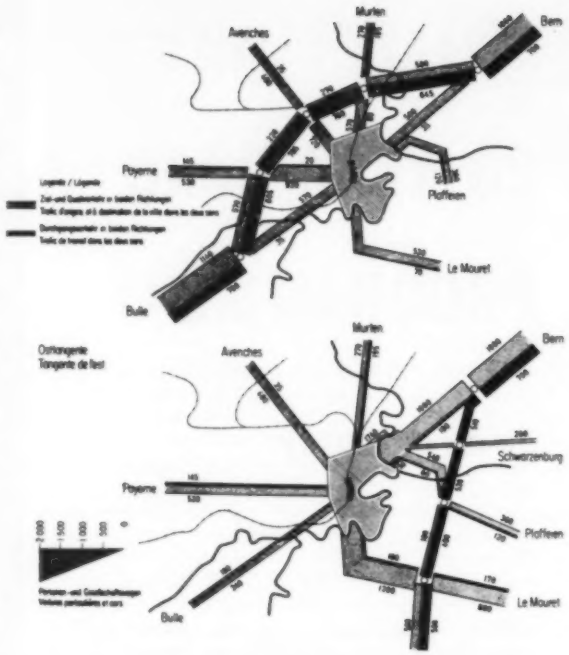


Fig. 1. An example of the detailed studies on which the Swiss Road Plan was based, it shows the calculated traffic distribution near Fribourg by two alternatives (west and east) of a motorway. Shaded: traffic for or from the town; black: through traffic. Figures refer to traffic in both directions, based on a census of 11th July, 1955.

Design Standards

The proposed national roads are classified in three categories. First class roads will be 'motorways' in the full meaning of the word. Second class roads will be also exclusively for motor-traffic with limited access, but they will not necessarily have hard shoulders nor a central reserve, and they may have less than four lanes. Grade separation at intersections is recommended, but not required. Third class roads have fewer requirements, that is lower standards.

The design standards proposed for the three classes of roads are given in the table below.

Design speed	75	62½	50 m.p.h.
Radius of horizontal curves			
normal minimum	2,300	1,500	900 feet
absolute minimum	1,500	900	600 feet
Radius of vertical summit-curves			
normal minimum	10	5.5	2.5 miles
absolute minimum	7.5	3.8	2.5 miles
Lane width	11½	11½	11½ feet
Free height	14½	14½	14½ feet
Gradients	3% (at the most 5%)	3%	8%
Stopping distance	800	570	380 feet

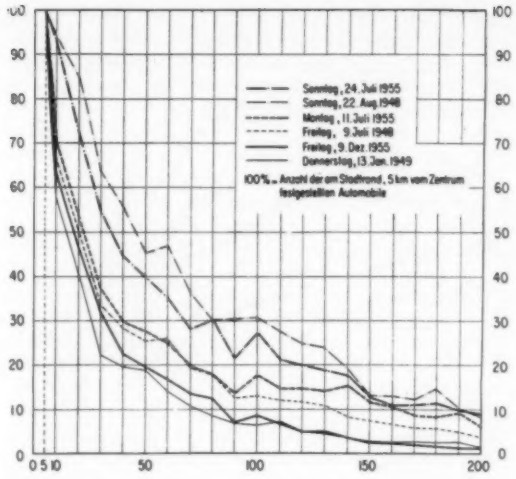
Sight distances must be double the stopping distances on two-way carriageways.

The capacity of the roads is evaluated at 2,000 passenger-car-units per hour for two lane roads, 3,000 p.c.u. for three lane roads, and 8,000 p.c.u. for four lane roads with a central reserve. The traffic densities to be admitted in practice are, however, respectively put at 1,000, 1,500 and 4,000 p.c.u. per hour (i.e. for the 30th hour a year in density) or 4,000, 6,000 and 25,000 per average day. Reductions for impediments, etc. are to be applied according to the American Highway Capacity Manual.

Three lane two-way carriageways are not rejected in good visual conditions, i.e. on mostly straight alignments. Experience shows that head-on collisions on the centre lane are rare. Due to the topography straight alignments are seldom possible; but especially for two-way carriageways they are recommended up to a length of three miles. Transition curves in the form of clothoides are recommended.

The design for a normal cross-section for motorways is two carriageways of 23 feet, each flanked on both sides with a marking ribbon 1 ft. 7 in. wide and on the outside with a hard shoulder of 8 ft. 2 in. and a green shoulder of 1 ft. 7 in. The central reserve is 13 ft. wide. The total width of the crown of 85 ft. may be diminished to 62 ft. in difficult conditions, the carriageways being kept at the same width. Perhaps the fact that many big cuts and fills are necessary influenced the decision not to make the crown widths too ample or to recommend wider central reserves. It should be remembered that the Swiss value their agricultural ground very highly.

With only slight deviations the cross-sections of European motorways are getting standardized. This


Sonntag, 24. Juli 1955
Sonntag, 22. Aug. 1948
Montag, 11. Juli 1955
Freitag, 9. Juli 1948
Freitag, 9. Dez. 1955
Donnerstag, 13. Jan. 1949
100% = Anzahl der am Stadtrand, 5 km vom Zentrum festgestellten Automobile

Trip lengths of cars leaving Basle on six days. Horizontal: length of trip from centre of Basle. Vertical: percentage, 100 per cent is the number counted on city border, 5 kilometres from the centre. The two top curves refer to Sunday traffic.

is a pity, for in this way the roads will have a very similar aspect, which threatens to give rise to monotony. It would be advisable to stress the desirability of a variation in the widths of the central reserves and of the green shoulders; this will also give the possibility of fitting the road in a pleasant way into the landscape. And moreover, the far from hypothetical danger of head-on collisions with vehicles cutting through the central reserve will disappear, and blinding by headlights at night will be totally excluded. In many cases the value of the extra land required is negligible and even in agricultural regions a short calculation shows that the extra loss of area does not amount to very much, considering what is gained by it for millions of travellers year after year.

Tunnels proposed for motorways are to consist of two one-way tubes, of vaulted cross-section, 29 ft. between kerbs in short tunnels and 24 ft. in long tunnels; the latter having on the outside a distance of 3 ft. 3 in. between kerb and wall supposedly for inspection, etc. This distance is in the other cases 1ft. 8 in. to 2 ft.

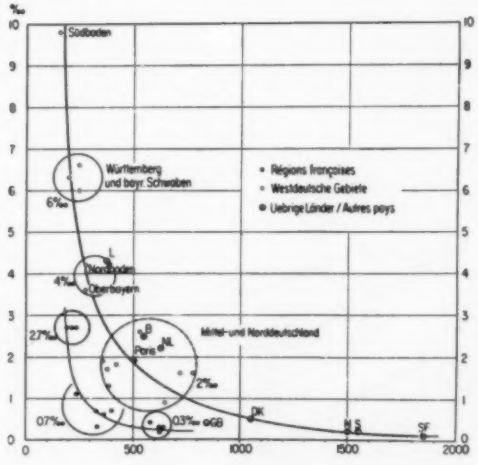
In order to make a plan for a net of motorways very extensive studies have been made. The country has been divided into sections in each of which a committee has investigated numerous possible itineraries of roads and combinations of them. Some of them could be rejected after a first inspection; where alternative alignments remained comparisons have been made taking into account among other items estimated costs, traffic properties (rise and fall, etc.), expected amount of traffic, traffic diversion from existing roads, regional benefits and disadvantages, national advantages, and an economic assessment of a motorway. Sometimes the problem was easy to solve, e.g. from Geneva to Lausanne one location for a motorway follows practically directly from the topography and the report gives ten pages to it. But for the motorway between Lausanne and Berne four alternatives had to be compared, which takes 40 pages of the report. The costs of the motorways are estimated to be from £250,000 to £500,000 a mile; those of (double) tunnels in average £1½ million a mile.

To give the comparisons as much as possible a mathematical character, certain standards have been developed. In order to take account of the difference of rise and fall in alternative locations, a 'virtual' length has been introduced, based on fuel consumption and on travel time. It is stated that for passenger cars rise and fall compensate each other practically if gradients are not more than 5 per cent. As to time loss an 8 h.p. car, the Opel-Rekord, travelling at 62 m.p.h. can be taken as representative, with up to 3.5 per cent gradient no decrease of velocity assumed. A 5 per cent gradient lowers the speed to 50 m.p.h., or 20 per cent. But since motorways are not supposed to have steeper inclines than 3 per cent, a 'virtual' length has not to be applied with regard to passenger cars. For commercial vehicles, being of more divergent types, the problem is more complicated and use is made of some data from other countries. The result is that for fuel consumption and travel time combined virtual lengths of upward gradients of 2.5 to 3 per cent are to be put at 116 per cent and for gradients of 5 to 5.5 per cent at 167 per cent of the real length.

Origin and destination counts have been available only in some cases to estimate future traffic on the alternative itineraries. But the general traffic census in 1955 taken at 400 points, during which on four days the cantonal licence plates were noted of the vehicles from the seven largest cantons, gave a basis as to inter-cantonal traffic. For traffic inside the cantons the same census was used and analysed with the help of what the report calls the Lillsche law:

$$Q = c \frac{A1 \cdot A2}{r^n}$$

in which Q is the number of vehicles moving between two places having respectively A1 and A2 vehicles;



Automobiles from different regions and countries on Swiss passes on four days; August 1953. Horizontal: distance to point of origin. Vertical: cars counted, expressed as 1/1000th of number in different regions and countries. Full dots: French regions. Open dots: German regions. Dots and circles: other countries.

r the distance between these places and n = 1.5, whereas c is a coefficient dependent on conditions, on average of the order of magnitude of 0.001 (with r in kilometers), and to be found by checking with the observed traffic volumes.

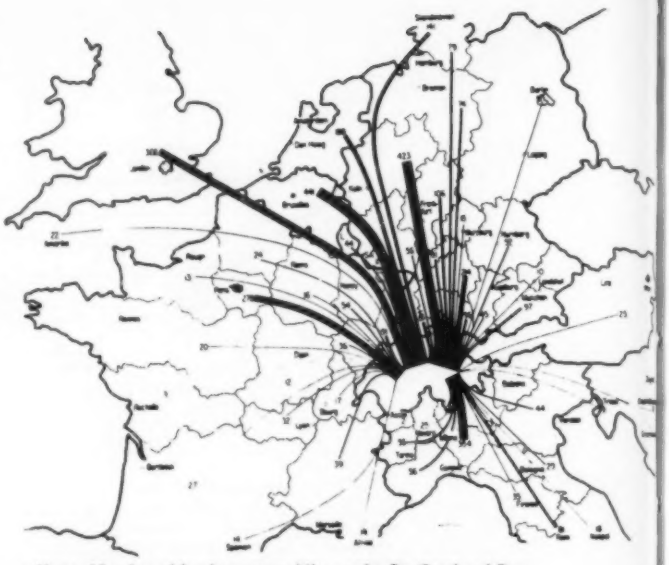
How much of the future traffic will stay on the old roads and how much will use an available motorway will depend on the relation of travel distance as well as of travel time along the two itineraries. Use is made of American observations on the Shirley Highway (near Washington, D.C.); in most cases 70 to 90 per cent of the traffic is expected to prefer the motorway. The calculations are based on speeds of 53 m.p.h. on motorways, 31 (sometimes 38) m.p.h. on existing rural roads and 22 m.p.h. on urban roads. It should be remembered that motorways are only envisaged in the lower, not mountainous, part of the country.

The results based on the census of 1955 are multiplied by 2.5 to account for the expected increase of the number of automobiles in the country and abroad. The report however explicitly does not add a percentage for 'new' traffic, as a result of the greater ease of traffic along motorways, which it states will certainly enhance their use, because an estimate of this increase cannot be given with any security.

Estimated Savings

Regional benefits of the construction of motorways result from the fact that a given region of the country, or of a canton, will be in easier reach of the economical centres of the country. Where the choice of alternatives for a motorway was difficult this factor was taken into account with the help of elaborate computations. The report contains a number of maps giving in different shades the zones where the saving in travel time between cities will be 0-10, 10-20, etc., up to 50-60 minutes. Based on the above-mentioned formula, an estimate of the number of vehicle-hours per day that will be saved is derived.

A points system has been developed to compare the values for neighbouring cities and villages of their proximity to a motorway. According to the report the traffic-behaviour of people varies widely with the size of the town or village they live in;



Above. Number of foreign automobiles on the St. Gotthard Pass according to country of origin: total of four days in August, 1953. Below the same for the Simplon Pass.

citizens of the larger cities generate *per capita* four times as much motor traffic as inhabitants of small agricultural settlements, towns with some industry and smaller cities lying between. This seems to be supported by data from the railways. A second factor is the size of the considered town or village and a third is its distance to the nearest motorway access point, a greater distance giving a rapidly decreasing relation with the motorway, approaching zero at 20 miles.

Crossing the Alps

Volume 5 of the report is dedicated to road connections across the Alps. In this volume of almost 200 pages a very thorough and comprehensive study is made of traffic crossing the Alps from in and outside Switzerland, its origins and destinations, the traffic relation between regions to the north and the south of the mountains, the seasonal and daily fluctuations, the estimated development of traffic up to 1980, etc. Special observations have been made about queue-building, velocities and capacities on mountainous roads. Moreover meteorological data are assembled.

To meet traffic demands three possibilities have to be studied:

(*a*) Improvement of the roads over the passes. Since in practically all of the cases it is not possible to keep them free from snow in wintertime this solution is not a total one;

(*b*) improvement of the transport of cars by train through the St. Gotthard and Simplon Tunnels to take up winter traffic and to divert a certain amount of summer traffic from the road over the passes;

(*c*) driving of new tunnels at such an altitude that it is possible to keep their access roads open during the entire year, as is being done between France and Italy through Mont Blanc.

For the St. Gotthard route (the most important trans-alpine connection and the historic background of the Swiss confederacy) the Commission comes to the conclusion that the improvements at present envisaged by the railways management will suffice

up to 1980; also the pass-road itself (Goschenen-Airolo) will be sufficient for a long time after the present improvement works have been carried out. Hourly traffic densities up to 800 or even 1,000 passenger car-units are possible with a reduction of speed to 20 or 25 m.p.h. due to the steep gradients. But the accesses at both sides (from the Vierwaldstattersee to Goschenen, and from Airolo to Bellinzona) will have to be improved by construction of a new two-lane second or third class road, separate from the existing road and by-passing built-up areas. In time it can be decided which solution is to be preferred for a further increase in capacity; either the construction of a second railway tunnel with provisions for the transport of cars or the construction of a special road tunnel.

The Simplon railway tunnel does not at present make as good a provision for the transport of cars as the St. Gotthard tunnel, but according to the report it can be improved in such a way that it will meet winter demands up to 1980, even if no Mont Blanc tunnel nor a Great St. Bernard tunnel is constructed. The road over the pass should be improved to two-lane third class standards and snow clearing services should be organized to keep it open, except in January, February and March. Here also the Commission does not recommend a special road tunnel.

Such tunnels are however advocated on two itineraries: the connection of the upper Rhine valley (Chur) with Bellinzona, Lugano and Locarno over the San Bernardino, and the connection of Berne via Thun with the upper Rhone Valley and the Simplon pass. A Great St. Bernard tunnel is calculated not to be economically justified due to the close proximity of the Mont Blanc tunnel. The report gives an elaborate comparison of normal ventilated road tunnels and tunnels with transport of cars on railway wagons. The latter solution should be considered when the length of the tunnel exceeds six miles.

National Roads Programme

In the last volume of the report the Commission comes to its final proposals for a network of national roads, a programme for its construction, its financing and its economic justification. With the financial showdown in sight the Commission lowers slightly its target as to the motorway scheme. It introduces the idea of 'semi-motorways', two-lane two-way roads of the second class, built in such a way that a second carriageway can easily be added so as to form a real motorway. This would give a saving of about one-third and the eventual completion would not incur other than very slight loss of what has been built. Funds are limited and the amount saved can be put to better use on other objects. Roads of this kind in view of their good alignments could carry easily 6,000 passenger-car-units per average day, which density is not predicted for 1980 on a number of

The new road at Schollenen Gorge with the old road below.

sections of the initially proposed motorways. These sections are, therefore, put in the second class. This reasoning seems sensible but doubts may arise whether in this prosperous densely-populated country traffic volumes will not surpass far earlier the prognosis e.g. on the above-mentioned road Lausanne-Berne of which a part is brought down to the second class and which will constitute the main artery for the connection of Berne with Lausanne and Geneva all of them sizeable towns. However, construction of the second carriageway is always possible at the moment when it is needed and if traffic grows faster than predicted more money will be available.

Final Proposals—Financing the Cost

The final proposal for the national road network gives a total length of 360 miles of class 1 (motorways) 350 miles of class 2 (inclusive 'semi-motorways') and 340 miles of class 3 (including of the three trans-alpine routes totalling 260 miles). The construction programme is divided into two parts; the first part to be concluded in 1969 is estimated to cost £240 million and the second part to end in 1980 will cost £71 million. The report proposes that the roads of this national network be financed and designed by the Federal Government, and that construction and maintenance be the duty of the cantons. Financing is a great problem. A toll system is rejected. With toll-booths on all of the 180 projected access points cost of collection would approximate £1,200,000 a year. Also part of the traffic might then avoid the new roads by continuing to go through the built-up areas. Suggestions have been made, but not accepted, for a system by which vehicles obtain the right to use the roads by paying an annual lump sum. Even for the tunnels no tolls seem to be recommended. An elaborate study leads the Commission to the following financial system. Of the revenue of the present petrol-taxes, 20 per cent would be used for the national roads (the cantons receive now 40 per cent and will continue to do so according to the proposal; the rest goes to the treasury); moreover an extra tax of 2½d. a gallon would be added to the petrol tax exclusively for the new road system. Loans would be issued to be repaid by the same sources after the completion of the work; according to whether an optimistic or a pessimistic view is taken of the growth of motorization the repayment would cease either in 1994 or in 2021.

Economic Benefits

A chapter is added to evaluate the economic benefit of the proposed road system. Running and maintenance costs of motor vehicles are put at about 4½d. a mile, of which 25 per cent would be saved on motorways, giving in 1980 a total saving of almost £6 million annually. To this must be added the saving in time, in so far as it is of economic importance, to which is attributed a value of £8½ million per year in 1980. The reduction of accidents that can be expected accounts for a further benefit of £1.3 million per year. The sum of these benefits is only slightly less than the annual costs of rents, amortization and maintenance, which the report concludes, justifies the investment. Attention is also drawn to other benefits that are difficult to calculate, e.g. for industry, trade, agriculture and tourism in more easily attainable districts, and on account of the greater tranquillity and safety on old roads, particularly in built-up areas. The report ends with a project of law to realize the proposals.

REFERENCE

'Die Planung des Schweizerischchen Nationalstrassennetzes', Eidgenossische Drucksachen-und-Materialzentrale, Bern 1959.

The photographs are reproduced by courtesy of the Swiss National Tourist Office.

London's Answer (*Concluded from page* 198).

own view is that a first rate public transport system is the sheet anchor of any plan for urban travel. The Russians and the Italians are among those ready to confirm this up to the hilt, as witness the new underground railways in Leningrad, Kiev, Milan and other cities.

The Nugent Report, in its wide approach to the whole problem, an approach so much in keeping with the attitude advanced by Sir William Holford in his already mentioned introduction to the New Ways for London report, also sets out the enormous advantages of pedestrian segregation, mentioning both the South Bank and Barbican schemes with pedestrian walkways at the 28 feet level. Later, Mr. Marples was to echo this aspect of Nugent thinking in no uncertain terms.

All these ideas in no way exhausted the fertility of thinking within the Nugent Committee. Ideas were advanced on the provision of loading and unloading facilities in new developments, on the question of staggered hours, on the need for the comprehensive application of traffic engineering in London, on the need for long term government programming of urban roads free of the shackles of the Treasury, and much else besides; not least a strong hint about Christmas traffic and adumbrating the advent of the Pink Zone.

As I have already said, the Nugent Report represented mature and balanced thinking in the widest possible terms. It is my view that it paves the way for better transport in London without harshly altering the character of the area, which should surely be dealt with in terms of both motorist and pedestrian, and of London as the home of a great people of many and varied interests. London must not become just a soulless city dedicated to the modern god of the motor car and the twin industries of oil and motor production which have already worked their will so disastrously upon the continent of America.

NEXT MONTH

In connection with **INTERNATIONAL ROAD SAFETY CONGRESS, NICE, October 3rd to 5th, 1960** the SEPTEMBER ISSUE will contain

Special Articles:

Road and Traffic Safety

America *Burton W. Marsh*
Belgium *H. Hondermarcq*
Italy *Vittorio Fornario*

TRAFFIC AND ROAD PLANNING DUBLIN

Professor Dr. Ing.habil

Max-Erich Feuchtinger

Last year Dr. Feuchtinger was invited to report on Dublin's Traffic problems and in December, when he made his report to the Dublin Corporation, he emphasized that his opinions were first impressions during a short visit, and might be different after a detailed survey. Dr. Feuchtinger gave 'Traffic Engineering and Control' permission to publish the report prior to his sad death in June. As it constitutes his last study outside of Germany, and because it is so characteristic of his methods, it was decided to proceed with its publication in full.

THIS preliminary report is in two parts. The first deals with immediate measures by which improvement of the traffic flow can be effected quickly. In the second, a working programme for traffic surveys is proposed, with the aid of which the General Traffic Plan, as a part of the development plan for Dublin, and recommendations for long term improvements, can be submitted. These traffic surveys are proposed for three forms of traffic: flowing traffic, parking traffic and public transport.

The road traffic in Dublin has not yet reached that stage which could be called a 'traffic chaos'. In general, the traffic still flows and there need be no talk of a real breakdown in the inner city traffic caused by the slightest irregular disturbance as often happens in other European capitals.

The available traffic space is not used to the maximum extent, the reasons for which include:

(*a*) Useful street space is occupied by parking vehicles;
(*b*) lane-driving is unusual as road markings are almost completely missing;
(*c*) traffic signals are operated for single intersections and not as a co-ordinated system ('Green wave');
(*d*) the advantages of one-way streets are not appreciated enough;
(*e*) buses are not operated in co-ordination with the other road traffic, especially in respect of bus stops;
(*f*) the road behaviour is too individualistic and there is too little 'co-driving', for instance.

Further, the motorized traffic is very often too fast and without consideration, the two-wheeled traffic shows very bad discipline, and the pedestrian traffic is not respected enough.

From these and other observations some proposals for the immediate improvement of road traffic are made.

Street Parking

In 1955 it was proved by test-driving that the travelling speed in the city centre is on average less than 10 m.p.h. (today it would be still less). This is not a result of a congested road network, but mainly a result of the obstruction of the flowing traffic by the parking traffic.

The first measure for improvement would be not only to prohibit all parking at places where street parking noticeably obstructs flowing traffic in regard to speed and safety, but also to enforce this prohibition. This is not being done in Dublin. Therefore, the following measures are recommended:

(*a*) Strict prohibition of stopping at the kerbside at all places where the stopping of vehicles would block the flow of traffic, i.e. in streets which are loaded up to the limit of their capacity and which also carry a large proportion of two-wheeled traffic, before and after traffic signals, before and after bus stops, etc.
(*b*) Prohibition of parking with certain time limits

according to local conditions. But the limits of the zone should be clearly indicated by signs. At present, for example, the limits of the 20 minute parking zones are not clearly shown.

(*c*) Limited parking in the zones of heavy traffic in the city centre to increase the turnover of parked vehicles, in order to secure parking for a maximum number of vehicles on a given space.

(*d*) Use of parking meters to enforce time limits for parking, thus collecting money to finance new off-street parking facilities. There should be a separation of short-term parkers (kerbside parking) and long-term parkers (off-street car parks and parking garages).

(*e*) Loading and unloading should not be allowed in periods of heavy traffic but should be restricted to the early morning and late evening.

(*f*) Severe penalties for improper parking including, if necessary, the towing away of vehicles which block the flowing traffic.

It should be understood that these preliminary measures can only be applied after having been examined in accordance with the local conditions and that they should not be applied schematically.

Road Markings

Lane driving in Dublin is far from satisfactory chiefly due to the indiscriminate and irregular kerbside parking. Until the part of the carriageway which is to be reserved for parking traffic has been visually separated, it will not be possible to divide by means of lane markings the road space which is reserved for the flowing traffic. This is essential in streets with a high proportion of bicycle traffic. If the parked traffic is regulated, it will also be possible to force the cyclists to use a cycle track that could be provided at the kerb. The lack of this regulation of parking causes cyclists continually to cut into traffic.

In the area of intersections, road markings separate the traffic flow (straight on, left and right turning) and thus increase capacity. Road marking increases capacity also on bends, on roads where sight is restricted on narrow sections, etc. It may be noted that a short time ago uniform regulations for road markings in the European countries were decided upon. It is recommended that the Irish regulations be based upon these.

Traffic Signals

In Dublin the traffic signals are not operated so as to get the most out of them, especially in respect of the different traffic loads. Most signals are singly operated and have two phases. The following forms of signal-operation are not in use:

(*a*) The co-ordination of several intersections to a system of green waves;

(*b*) the arrangement of signals to fit more accurately the traffic needs, for instance heavy turning streams by multi-phase operation;

(*c*) the provision of greater safety for pedestrians at places with heavy pedestrian traffic by special phases or parts of phases.

More detailed investigation is necessary to decide to what extent it will be possible to improve the existing signals, or to provide new installations, or even to recommend a central signal operation, etc. To ensure optimal results from these investigations, only qualified engineers with special knowledge in traffic engineering should be entrusted with the work. This is especially important for the installation of new traffic signals.

Those intersections which are controlled by police officers should have traffic signals installed.

Channelized Intersections

It is noted that channelization of intersections is not used in or around Dublin. Channelization not only regulates the traffic flow but also increases safety at critical intersections. It is useful when traffic loads are not so great as to justify traffic signals. But a well-channelized intersection can be converted to signals later without reconstruction.

Channelization means dividing traffic flow by channelizing islands so that:

(*a*) The conflict points of the intersection are separated;

(*b*) sufficient queuing space is provided between the conflict points;

(*c*) an easy-flowing traffic stream results from a lay-out which is designed in the light of vehicle movements.

It is recommended that those intersections where most accidents occur which can be improved by channelization should be ascertained by means of conflict-diagrams—such diagrams should in any event be introduced.

One-way Streets

Traffic troubles in the city can often be eased simply by means of one-way streets. It is noticeable that this device is used very rarely in Dublin. It is recommended, therefore, that a systematic research to ascertain which streets of the city road network are suitable for one-way traffic be undertaken. This, of course, includes the public transport traffic, because the buses have to obey the one-way regulation.

A special task in this connection is an investigation of the possibilities of using the two embankment roads of the River Liffey from Butt Bridge to Kingsbridge as reversible one-way streets. The author sees in this a chance of a remarkable increase of capacity for the east-west traffic by relatively simple means. It would even be equal in potential to constructional works such as rebuilding one of the Liffey bridges, because these one-way streets would do away with today's traffic jams at the bridge heads, where normal traffic flow is impossible as long as there is two-way traffic on the embankment roads.

It should be mentioned that opposition to one-way traffic by the population should not be taken too seriously, because this is—as experience has proved in the U.S.A. as well as in Europe—not justified, and will cease a short time after the regulations have been introduced. For instance, in shopping streets business increases instead of diminishing. The introduction of one-way traffic, which diminishes the conflicts between vehicular traffic and pedestrian traffic makes it possible also to allow more parking.

Bus Traffic

It is definitely an advantage that Dublin eliminated trams and is operating its traffic completely by buses. This is a remarkable step for a town with a population of 700,000 inhabitants and means that when adapting the city road network to the growing traffic demand, difficulties will not arise from rail-bound traffic.

Although the bus traffic seems to have a fairly easy flow, the author got the impression—which has to be verified by detailed research—that the existing bus network is partly too concentrated. The reason for it may be that buses operate in all streets where formerly there were tram-cars. This being so, one of the greatest advantages of bus traffic, a free use of the full road network, has not, or at least not sufficiently been employed. An advantage of bus traffic is

that the routes can be changed anytime—after of course the traffic needs have been investigated. Closely connected with this are certain concentrations at bus stops and bus terminals. Here too, detailed investigations should find out to what extent improvements are possible where the present concentration disturbs the traffic flow.

Traffic Education

Observing road traffic in Dublin, one gets the impression that some improvements could be gained by traffic education under the motto 'co-operation is the only way'. The author does not desire to list the numerous well-known measures for traffic education, but wishes to point out only some which are also connected with technical measures.

Most important is the education of the children as the road users 'of tomorrow'. In this respect very much is lacking. During local visits and car trips the author experienced some critical traffic situations where children were involved, which seem to be a hint that better care for children is necessary (traffic-nursery, traffic education in schools, etc.). A very praiseworthy and very well organized beginning has been made already with the School Safety Patrol.

In the same way the safety of pedestrian traffic can be increased by educational and technical means. According to the official accident records, one-third of the people killed by traffic are pedestrians (another third are cyclists). This seems to show bad traffic discipline. Technical aids for the improvement of pedestrian traffic consist mainly of Zebra crossings, separate pedestrian phases at signal-controlled intersections, special pedestrian signals (calling by push-button), pedestrian overpasses, and pedestrian subways.

Speed Limits

The relatively high figure of 60 persons killed in Dublin road traffic per year gives a lead for research on accidents in connection with the speed factor. This as well as speed checks and observation of actual traffic flow can indicate which kind of speed limit is advisable, such as general speed limit in built-up areas, special speed limits for some streets (radial arteries, narrow roads with restricted sight, roads with a heavy load of cycle traffic, etc.) or whether the present unlimited speed is preferable.

Working Times

In Dublin two separate working periods are usual, resulting in peak-hour traffic four times daily. By introducing an uninterrupted working day, this could be reduced to two rush hours, one in the morning and one in the evening. This would mean considerable economy for motor vehicle traffic as well as for public passenger transport.

Having regard to the size of the city, it should, in the opinion of the author, be seriously considered whether the following remedies could be used.

(*a*) The uninterrupted working day, which would eliminate two peak traffic periods;
(*b*) working periods in echelon, which would cut down the height of the remaining two peak hours.

These two measures may prove unpopular in the first instance, but they ease the traffic problem in a very simple way to an extent that justifies any efforts to carry them through.

Road Traffic and Town Planning

Sound town planning prevents unnecessary traffic and thus we get at the root of the causes of traffic jams in the city. This is a basic universal principle, that should never be neglected.

The example of the cattle-market in Dublin shows how important siting is for buildings and places which generate traffic. If the market area were situated near the harbour, then the weekly cattle driving from the market to the harbour through the whole of the city would be stopped.

It is impossible to deal in this report with all problems connecting traffic with town planning. But it is a fundamental requirement that everything which may lead to traffic congestion should be avoided by co-ordinated town planning. Up to now, in this respect, nothing has been spoiled in Dublin. There are hardly any traffic generating buildings or high buildings in the city. Rebuilding of slum quarters has not yet started in the city. But the development should be watched carefully, because the traffic engineer cannot readily correct faults in town planning. The author does not, for instance, regard as desirable the development of large school buildings for 2,000 or more children. The first principle in the provision of new school buildings should be to provide for the children the shortest possible routes and routes free of interference from road traffic (safety for the children from the danger of road traffic).

General Traffic Plan

The planning of the network has to be based on the development plan for the City and must, if possible, have regard for traffic projects already decided upon. But the future development of traffic in the planning district (Dublin and surroundings) and over the planning period (20-25 years) must also be taken into consideration.

Firstly, a 'traffic analysis' must be carried out which will give information regarding the present structure of traffic and from which clues for effective planning may be derived. Then a plan for the road network must be worked out, of which several variants will have to be investigated. Traffic analysis will be followed by 'traffic prognosis', i.e. the planned road network will be loaded with future traffic and a prediction will be made of the traffic as it will be at the target date for the planning. The last stage, namely that of 'traffic diagnosis' provides verification of whether or not the traffic facilities for the major road network have been adequately dimensioned and whether it is the most effective solution.

Traffic Analysis

The traffic analysis consists of several traffic counts and origin-destination studies in the town under survey from which the existing traffic structure will be derived.

As a counting method the double-cordon count (alternatively, three-fold cordon) will be recommended. It gives information about the origin and destination of the external and the internal traffic. Traffic Counts and O. and D. studies should be carried out, not only at the inner and outer cordon but also on all bridges of the River Liffey. In addition, special counts will be necessary on the question of a road bridge crossing the port.

Recommendations for carrying out the traffic counts will be given by the consultant. Preparing, carrying out and working out of data of the traffic survey will be made by the City administration. Further investigation in regard to the survey will be conducted by the consultant with the aid of the data from the traffic count.

The following conditions must be fulfilled to ensure the accurate conducting of the traffic counts:

(*a*) A qualified engineer with some additional help must officially prepare, carry out and analyse the counts.
(*b*) For the traffic count itself, several hundred counting personnel (students, pupils, city officials) as well as a certain number of police officers (to stop the vehicles) will be needed for some days.
(*c*) The analysis is based upon the assumption that punch cards are used to save time and personnel.

After the results of the counts have been listed, the consultant takes over and the further work includes the graphical drawing of the listed data.

Planning

The consultant carries out the planning of the future main road network in co-operation with the city administration. From first impressions, the author considers the following questions will be of great importance:

(*a*) The building line in the city fixed some time ago;
(*b*) the north-south arterial planned in the city;
(*c*) the bridge planned to cross the harbour;
(*d*) the widening of the embankment roads on both sides of the Grand Canal to an east-west expressway;
(*e*) the reconstruction or widening of radial roads, especially alongside the coast and on the permanent way of the closed railway line between Harcourt Street and Shankill.

It must be assumed for the planning of the future road network that an approved development plan for Dublin is in existence, which shows the future expansion of the City, with the distribution of inhabitants and industries, up to the target date for the planning. If several variants have to be investigated, these will have to be agreed in co-operation with the City administration.

Traffic Prognosis

The traffic prognosis will be carried out by the consultant. In the prognosis the traffic flows, as determined by the analysis, will be assigned to the new future road network. In addition, the probable traffic growth will be ascertained, and the result will be a predicted traffic load for the future road network at the target date for the planning. If several variants have to be investigated, the prognosis will be conducted for each plan.

Traffic Diagnosis

The traffic diagnosis will also be carried out by the consultant. Here the traffic capacity of the future main road network will be ascertained and compared with the prognosis traffic load. This will prove whether the new road system is correctly and appropriately dimensioned. In addition, it has to be ascertained by comparison of the several plans which is the most effective.

Parking Facilities

The adoption of a detailed working programme for the 'parking facilities' section of the General Traffic Plan, cannot be recommended at this stage, as it will be influenced mainly by the result of the above dealing with the future road network. However, this survey of the parking traffic can easily be carried out in conjunction with that of the flowing traffic.

The following working steps are to be considered:

(1) Analysis of parking traffic, i.e. inquiries about present supply of parking space, inquiries about present use of parking space, inquiries about parking time and parking purpose.
(2) Inquiries about future parking needs in regard to the development of motorization, the development of the built up area and its utilization.
(3) Planning of parking facilities to meet the future parking needs.

The leading planning principle will be that the valuable parking space in the City will be reserved for short-time parkers (with the aid of parking meters) and the long-time parkers will be provided for by multi-floored garages at the margin of the City.

There is no objection of course to carrying out the survey regarding parking facilities in conjunction with the immediate measures proposed earlier if this seems to be desirable.

Public Transport Facilities

Decisions about the type of investigations to be carried out for the adaptation of public transport traffic to the future main road network can only be made when the traffic analysis for the General Traffic Plan is finished. Here also, as in regard to parking facilities, it is not advisable to set up a detailed working programme at this stage.

The public transport network being bus-lines, it will not be difficult to carry out the adaptation to the future road network. There will be no need for any constructional works except bus kerb loading bays.

The author did not have any opportunity to contact the Dublin Public Transport Authority. Therefore, it is not possible to make any recommendations in regard to the necessity for certain public transport surveys. But it would complete the picture of the present traffic structure if O. and D. studies for public passenger transport were carried out analogous to those for private road traffic. The traffic analysis will show during its course whether and to what extent this will prove necessary.

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KERB PARKING CONTROL

by W. L. CARSON, Traffic Engineer,

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An American department store's answer to restriction on kerbside parking in a congested 'downtown' area. A car ramp garage for 524 customers' cars.

PARKING is an integral part of highway transportation and cannot be divorced from the other elements of road transport service. It is important not only that new vehicle parking and terminal facilities be provided as needed but also that efficient usage be made of existing spaces. The provision and control of both kerb and off-street parking spaces should be closely co-ordinated with that of new streets and roads. Proper control and regulation of kerb parking is an important factor in securing optimum utility and benefit from existing streets. By applying traffic engineering principles and methods in determining the use of street space for vehicle parking purposes, more efficient and safer traffic flow can be obtained, and the maximum service potential of parking spaces can be realized. To do less is to neglect a major aspect of highway transportation.

Kerb Parking in the United States

While many municipalities now have substantial amounts of parking space in off-street lots and garages, kerb spaces still serve the greater portion of parkers in United States communities. The proportion of downtown parkers that use kerb spaces ranges from about 90 per cent in communities of 5,000 to 10,000 population to approximately 50 per cent in cities of over 1,000,000 population. The larger the city the smaller the proportion of total parking spaces that are located at the kerb, due to the increased need to use kerb space for traffic movements, bus stops, etc. In the very large cities only about one-third of the kerb footage in downtown areas is devoted to parking.

Some general characteristics of the parking situation in the central business districts of U.S. municipalities are:

1. In small communities, there are usually two peak periods of parking demand (normally around 11 a.m. and 3 p.m.), while in large cities there tends to be just one parking 'peak' (around 1 p.m. or 2 p.m.).
2. Trucks account for about 15 per cent of all vehicles parked in downtown areas during the day.
3. The larger the city, the higher the average duration of time that vehicles are parked. The proportion of parkers parking for less than one hour ranges from 40 per cent in large cities to 75 per cent in small cities.
4. The average parking time of vehicles at the kerb is about one-fourth that of vehicles in off-street facilities.
5. The distance that parkers walk to their destinations varies directly with the size of the city and with the length of time parked.

The above characteristics are based on the results of parking studies in some 100 U.S. cities of varying population. While many of the above characteristics may be typical of the parking situation in communities of other countries, they are presented here primarily as an indication of the type of information that should be secured in analysing local parking conditions.

Priorities for Use of Kerb Space

In controlling usage of kerb space it is advisable to establish the following priorities:

1. Movement of vehicular traffic.
2. Loading and unloading of goods and passengers.
3. Short-term parking.
4. Long-term parking.

While it is important to observe the priorities listed above, the actual need for restricting kerb spaces to a specific use should be carefully determined before instituting regulatory measures. Such determinations should be based on a study and analysis of conditions at the particular location involved. There is no general rule or formula that can be applied in allocating kerb space among the various possible uses. In one area, for example, a critical lack of off-street space may require devoting considerable kerb footage to loading zones; while, in another area, it may be possible to handle most loading operations in off-street areas.

Parking Restrictions and Traffic Flow

By judicious and discriminate prohibition of kerb parking, the efficiency and safety of traffic movement can often be greatly improved. When based on proper

engineering study, the prohibition of kerb parking may frequently increase the traffic capacity of a signalized intersection by as much as 50 per cent, that of a street by 100 per cent. In a major eastern city in the United States, a daytime ban on kerb parking in the heart of the downtown business district helped make it possible to increase the average vehicle speed of private cars through that area by 50 per cent, and to decrease traffic accidents by nearly 10 per cent.

In many U.S. cities, kerb parking prohibitions on major streets are during peak traffic hours only. In such cases, kerb parking is usually prohibited for 2 or $2\frac{1}{2}$ hours during the morning and evening periods of heavy traffic flow. In a large western city in the United States the establishment of kerb parking prohibitions on some 250 miles of streets during the morning and evening peak traffic hours increased the speed of traffic flow by as much as 20 miles per hour. Periodic prohibition also helps to discourage all-day parking at the kerb. Peak hour prohibitions on kerb parking may be applied effectively to either one or both sides of the streets depending upon traffic flow characteristics and needs.

Seeking Optimum Benefits

Elimination of kerb parking for the purpose of expediting traffic flow should always be based upon a study of the traffic capacities of the streets and intersections involved, traffic volumes during various times of the day, and other pertinent data. (Special attention should be given to the possible need for eliminating a limited number of kerb spaces on intersection approaches so as to provide a lane for turning vehicles.) Parking prohibitions will not always produce significant traffic movement benefits, nor do such benefits necessarily outweigh the importance of providing parking space. The needs of moving traffic, however, should be given priority over those of parked vehicles whenever a major conflict arises.

In a number of U.S. communities all-night parking is prohibited on any street, and this is usually effected through an order restricting parking to 30 minutes during a three or four hour period in the early morning hours. Such restrictions are adopted primarily to expedite street maintenance operations, reduce crimes, and facilitate the detection of abandoned automobiles. Due to a shortage of off-street parking spaces, many communities have been unable to establish or enforce all-night parking restrictions; others have passed a law to allow parking on alternate sides of the street every other night.

Parallel Parking Preferred

Angle parking at the kerb has been eliminated in favour of parallel parking in most cities in the United States. While this conversion from angle to parallel parking reduces the number of spaces provided in a given length of kerb, sometimes by as much as 40 per cent, this disadvantage is almost always outweighed by improvements in traffic movement and safety. Not only does angle parking allow less street width for the movement of traffic, but it is also more hazardous because of the driver's restricted visibility in backing out of his stall. Generally, angle parking should be used only where the need for parking greatly exceeds that for traffic movement and where it will not contribute to accidents. Streets should usually be at least 70 feet wide and traffic movements quite light if angle parking is to be permitted. In one U.S. city, the conversion from angle parking to parallel parking on a principal downtown street increased average vehicle speeds by 35 per cent, increased traffic volumes by one-third, and decreased accidents by 30 per cent.

An American parking lot on the grand scale provided to overcome kerbside parking.

In the interest of road safety, it is imperative that kerb parking be generally prohibited at certain locations. Mostly this is to provide adequate sight distance for motorists approaching traffic control devices, pedestrian crossings, intersections, etc. In the United States, for instance, municipalities usually prohibit parking within 20 feet of a crossing, at an intersection, within 30 feet of a traffic control sign or signal, and within 50 feet of a railroad crossing.

Commercial Loading Zones

Since it is obviously important that commercial vehicles be allowed to load and unload as close to their destination as possible, the parking needs of such carriers must be given priority over those of private vehicles. However, such preference in the use of kerb space should be based upon a proper study of the space needs of commercial vehicles, of the possibility of controlling the times of loading and unloading operations, and of the feasibility of various concerns sharing loading areas. A loading zone programme should be developed to meet the needs of commercial loading operations with a minimum loss of kerb parking space. Attempts should also be made to secure efficient utilization of alleys and other off-street areas for the loading and unloading of goods. Some U.S. cities have passed zoning ordinances which require specific amounts of off-street loading space to be provided in connection with the construction of new buildings or major improvements in existing ones.

Bus Loading Zones

It is often necessary to assign a considerable amount of kerb footage to bus stops. However, by developing and following standard practices and policies in the location of passenger loading zones, the interference of bus movements with other traffic can be reduced, the length of kerb devoted to passenger loading zones can be minimized, pedestrian safety can be improved, and bus operations can be made more efficient. In the United States, recommended practices for the establishment of bus loading zones have been set forth in 'Proper Locations for Bus Stops', as developed by a committee of the Institute of Traffic Engineers.

Parking Time Limits

Of particular importance in achieving efficient usage of kerb parking spaces is the establishment of reasonable time restrictions. Time limits governing the use of parking spaces should correspond closely with the parking needs of motorists desiring to park at the location involved, with preference given to short-term parkers. This requires that a technical study be made of the nature of the parking demand and that data thus obtained be tabulated and analysed in a manner that will permit determination of proper time restrictions. Such a study normally includes a field survey of the arrival and departure times of vehicles parked in each kerb space, the exact destination of the parker, the type of vehicle parked, and the trip purposes of the driver.

Parking Signs and Markings

Parking prohibitions and restrictions, along with the times and days when they are in effect, should be clearly indicated on signs. In the United States, signs with red letters on a white background are used to specify parking prohibitions, while signs with green letters are used to indicate various types of parking restrictions. At locations where parking is prohibited at all times, kerbs are painted yellow. The use of kerb markings of different colours to indicate other parking regulations generally have not been effective.

Enforcement

The enforcement of established regulations is essential to efficient and safe kerb space usage. The enforceability of kerb regulations should be carefully considered before such controls are put into effect. Extensive disregard of kerb parking regulations may indicate that the regulations are not reasonable, that parking limits need adjusting, that parking signs are inadequate, that motorists are aware that enforcement is weak, or that the type and amount of parking space available to motorists is seriously inadequate. Parking time limits as well as parking prohibitions should be strictly enforced.

Kerb Parking Control Programme

The following is a suggested programme for securing optimum usage of kerb space:

1. Prepare a large map on which may be indicated, (perhaps by various symbols and colours) the location and amount of kerb footage devoted to different uses, time restrictions involved, whether spaces are metered or unmetered, etc. It is advisable to prepare the map in a manner that will permit easy revision as changes are made in kerb space usage and controls.
2. Conduct a field survey of the character of parking space usage—including parking durations, types of vehicles parked, trip purpose and destination of parkers.
3. Establish or revise time restrictions, parking prohibitions, etc., on the basis of data obtained in the field survey.
4. Review local laws governing kerb space usage to ascertain those which need amending in order to provide for proper control of kerb space.
5. Make a separate study of commercial loading operations, their requirements, and the extent to which existing loading areas, at the kerb and off-street, meet such needs.
6. Review parking signs and kerb markings as to propriety, placement, clarity, etc.
7. After reasonable and proper kerb regulations have been established institute a continuing enforcement programme.
8. Establish a definite procedure whereby periodic evaluation can be made of kerb parking controls and needed changes can be effected.

Conclusion

Controlling kerb space usage is not an adequate substitute for the provision of off-street parking facilities. Yet the institution of reasonable and sound kerb regulations can be extremely valuable in obtaining as much benefit as possible from existing streets. As parking and traffic demands grow, the importance of applying traffic engineering principles to street usage becomes even greater.

The newly completed Linton Bridge on the Ross-Tewkesbury Motorway. This is a two span reinforced concrete over-bridge of the concrete slab type, seated on rubber bearings. Typical of many bridges on this new section of motorway, the abutments are faced with locally quarried red sandstone.

PROJECTS AND A

IN PICTU

The Ludwigshaven Elevated Highway. This picture (below) shows the highway and a ramp leading down to a secondary road underneath. At the end of this highway, four 'fingers' on different levels will carry traffic towards its destination. On the left is a view of one of these 'fingers', with parking space underneath. The Chiswick-Langley part of the future M4 Motorway should look similar.

A short stretch of the Ross-Tewkesbury Motorway looking eastwards towards the Jay's Green Interchange area with the Dymock Forest in the background. This photograph and the one opposite are reproduced by permission of the contractors, Tarmac Civil Engineering Limited.

AND ACHIEVEMENTS

PICTURES

These workmen are hanging overhead signs in a busy centre of Stockholm. This move was made to overcome the danger of a driver taking his eyes off the road to search for a road sign. Below is a section of the outer ring road round Stockholm and this photograph shows well how much easier it is to read the signs over the road than the ones at the verge.

TRAFFIC PLANNING

STUTTGART

by Arthur Henderson

A consultant who was working with the late Professor Dr. Ing.habil Max-Erich Feuchtinger here critically examines, from the viewpoint of a British traffic engineer, methods employed to assess traffic needs in a German city.

Fig. 1. Main roads plan.

STUTTGART, capital of Schwabenland, is a historic and civic focal centre for a wide area of Southern Germany, and is the administrative capital for the Northern part of the Land Baden-Wuertemberg. The Land Government administration and the City Government are located in the centre of the city where the former owns a considerable amount of property and land.

The River Neckar plays an ever increasing role in the importance of Stuttgart as the rapidly developing port, opened in early 1958, has shown in the last two years. The river is navigable for Rhine barges up to 1,200 tons as far as Stuttgart port, and work is in progress to canalise the river further upstream another fifteen miles to Plochingen.

The City centre lies to the south-west of the River Neckar, which flows in from the south-east, past the port, and out up to the north. The main line railway from Munich follows the river, loops into the terminal Main Station at the city centre and on out again in a north-westerly direction to Mannheim and Frankfurt-on-Main. The principal highways approach the city through rapidly expanding village suburbs and on into the central areas of the valley city. These highways are merging with local street systems right into the central areas. Building development is highly concentrated into the 'city-core' in the valley bowl, and in lower densities in clusters around old village nuclei on the surrounding hills. Industry is concentrated along the River Neckar, port, and railway installations.

The City's total area of 80 square miles is occupied as follows:

Buildings and yards	14%
Streets, lanes, etc.	10%
Railways	2%
Green areas	29%
Farms and quarries	34%
Allotments	10%
Waterways	1%

Many street widths and alignments have already been improved where war-damage made space available for widening and increased intersection circulation. There is an extensive widening and realignment programme under construction which is being carried out gradually as leases of property fall in.

The greatest hazard and impediment in the streets and to the flow of traffic are the tramways. Almost all the central area main streets are cluttered up with tram lines, points, loading islands, and overhead power cables. Many street surfaces are still paved with old stone cobbles especially in the 'old town', but the main State routes through the city are by degrees being asphalt surfaced.

Current Traffic

In the last traffic census in 1952 there was a total flow in and out of the city of 94,500 'passenger-car-units' in a sixteen hour day (taken from 6 a.m. till 10 p.m.). It was estimated that more than 90 per cent of the traffic on the central area main streets was local and terminating traffic, and 10 per cent through traffic. 70 per cent was local city centre traffic, and this left 20 per cent as real terminating traffic. The picture would be quite different today on account of the increased motorization of Western Germany, and particularly in the Stuttgart region in the intervening years.

In 1959, Stuttgart ranked seventh in degree of motorization in Western Germany, with 144 vehicles per 1,000 head of population. The city came third in rank with private car ownership, having 98 cars per 1,000 population. The average in Western Germany was 130 for all types of motor vehicles and 59 for private cars.

The two greatest impediments to the free flow of motorized traffic are the tramway system and incorrectly parked cars. Stuttgart is not untypical of other large West German cities in that the tramway system has been rebuilt and modernized with large capital expenditure sunk on new equipment. Trains

Fig. 2. Paulinen Strasse overhead bridge.

of three tram-cars coupled together and articulated units are the rule and not the exception, and add greatly to congestion, especially at intersections.

In the city centre area of about 500 acres there are parking spaces for approximately 4,500 cars—in parking buildings, lots, and authorized street spaces.

The pedestrian comes off rather badly in Stuttgart. Firstly, because very few drivers see fit to give way at a pedestrian crossing unless it is signal controlled, and, secondly, because at many intersections the pedestrian phase on the signals does not permit crossing in one movement, and one must wait halfway across on an island refuge. There are three types of 'Zebra' crossing in Western Germany, and there is a great deal of vagueness and lack of discipline in the use of the third category: signal controlled; adopted flashing-beacon of 'Belisha' type; and the plain 'Zebra' by itself. At the flashing-beacon, all traffic should stop when a pedestrian attempts to cross. With the plain 'Zebra', when more than one person attempts to cross, the traffic should give way to the pedestrians.

Stuttgart is fortunate to have relatively few traffic troubles during normal working hours—there is no traffic stagnation, and parking is not impossible. This does not lead to complacency, however, as there are difficulties which build up quickly at peak hours and on 'Shopping-Saturdays', and in effect Stuttgart is only just managing to cope, and the City authorities are aware that trouble lurks just around the corner.

In order to take care of the increasing traffic pressures of the future—greater motorization and greater use of the private motor car—the city has for some time envisaged the development of a City Ring System of Highways surrounding the down town area. The Ring System, as can be seen in the plans at the head of this article, is part of and links directly with the National and State Highway routes, and with the Autobahns. A first section has been built near the Main Station, and partly completed sections link from here to the first half of the Paulinen Strasse overhead bridges. (Fig. 2). The Main Station intersection is not constructed with flyovers or underpasses, but it is planned so that at a later date the intersection capacity can be increased to accommodate higher densities with these free-flow characteristics.

Noteworthy features which exist in Stuttgart are the Wagenberg Tunnel (Fig. 3), intersection and signalization at Robert Bosch Hospital, the start of the City Ring at the Main Station (Fig. 4), Botnang Saddle overpass (Fig. 5), and the Paulinen Strasse overhead road.

Compared with other cities in Europe, Stuttgart has already made relatively good progress in the construction of new facilities, but the same method of haphazard planning cannot suffice for the future.

Development Programme

The Town Plan, drawn up in 1956, allows for an estimated maximum population of 800,000 to 850,000 for the area included within the city boundaries—approximately 80 square miles. This allows for only small expansion in existing built-up areas and for limited new estate development. Industrial expansion is not envisaged except on a limited scale with light industrial development.

Town planning responsibility within the city boundaries rests in the hands of the City of Stuttgart. Administratively town planning has its own staff and head of department, who is directly responsible to the Director of Building, and the City Council. Planning proposals which concern the city are prepared by the Land Finance Direction Department. The Land owns a large amount of property at strategic points in the centre of the city, including a very fine park system leading from the centre of the business district down to the River Neckar and Rosenstein Park. Here the Land authorities have put forward a studied proposal in order to preserve and enhance the amenity value of the parkland which they own. This involves comprehensive redevelopment, and unfortunately, heretofore, there has been no real meeting of minds between the City and State authorities on this type of planning. It requires

Fig. 3. The Wagenberg Tunnel.

co-operation and a comprehensive approach, together with a good business sense and foresight, as well as technical ability, and recently there has been some progress in this direction.

The Land proposes a 'Redevelopment Area' including an island of property lying between the main road, Neckar Strasse, and the park area (which is bordered along the other side by the railway approaches to the Main Station). The proposal includes the extension of green-space from the park-strip into wedges between tall building blocks erected at right angles to the park grounds. This proposal conflicts with the City plans for developing the existing highway which runs between the island of property and the park, using some of the park area for widening purposes. The required highway development, it is argued, cannot take place on the other side of the property island along Neckar Strasse. It is however quite clear that there is an opportunity for improving this part of the town in the years to come if the far-sighted proposal of the State is considered in a comprehensive manner. Should the highway be sunk along the parkside both parties objections are somewhat alleviated, and if this City quarter is comprehensively redeveloped, as suggested by the Land, then there is opportunity for sunken, level, or overhead road construction, entirely separate from but alongside Neckar Strasse. Other technical points involve the basic data derived from a forthcoming traffic analysis. This will reveal the future highway planning requirements for the Stuttgart area and also this particular section of the town. The question of limited access has not been solved in the present plans for developing the existing highway along the side of the park.

Traffic Planning

Until recently traffic planning has been conducted on an intuitive basis. This is unfortunate in so far as it causes ramifications in present and future planning programmes. Chances were missed after the war: plausible schemes were put forward but were ruled out on account of economy and expediency in an effort to get things going. Since then the physical and financial climate of Western Germany has changed, especially in Stuttgart.

Traffic planning is being carried out by a very limited but competent staff—a section of the City of Stuttgart Town Planning Department. The final execution and design is carried out by the Public Works Department. The most serious shortcoming has been—and still is—the lack of accurate information on traffic movement and 'desire-lines' in Stuttgart. It has now been realized that there can be no realistic traffic planning without full and accurate data on the density and flow of streams of traffic—full origin and destination surveys. This means co-ordinated surveys covering the central and outer sections of the city, from which a proper traffic analysis can be prepared along with adequate drawings. A traffic analysis is now in preparation, with the full origin and destination surveys already completed. It is being carried out by the Town Planning Department, Traffic Section, in conjunction with the Public Works Department. The outer suburb areas were counted and surveyed in the week following Easter, and the inner City areas were counted during the week after Whitsun. The information has been recorded directly on to I.B.M. cards, which are then punched and processed by an I.B.M. machine.

Fig. 4. Start of the City Ring.

In February this year, the City of Stuttgart published a Report on Public Transportation Facilities in the area. It was prepared by two Professors of the Technical University in Stuttgart: Dr. Ing W. Lambert and Dr. Ing.habil M-E. Feuchtinger. One main proposal was to put the tramway system underground in the central area, but the shortcomings are that many of the main routes leading out of the town will still be cluttered up with tramways above ground. This is only half a solution—and this is made quite clear in the summing up from the traffic engineering point of view. It is suggested that any proposals should be coupled with a comprehensive traffic plan for the Stuttgart Region aimed at the planning date of 1980.

New Facilities

The Botnang Saddle overpass bridge has been built on the western perimeter highway route to overcome an otherwise awkward intersection located in a natural topographical dip. The bridge caters for a single line of traffic in each direction. There is an exit ramp on the north end, an access ramp on the south-west side, and a combined entrance and exit ramp on the south-east side. The bridge satisfies the needs of today's traffic volumes, but there is no provision for expansion to multi-lane operation: the approaches are awkward to negotiate, with poor alignment and sight lines.

A short section of 'Green-Wave' signalling has been completed in conjunction with the intersection of five main roads and a sixth at the Robert Bosch Hospital—North-West section of the City Ring System. The green-wave totals about 800 yards long, and has speed settings of 20, 25, and 30 m.p.h. depending on the time of day and the density of traffic. The signals are fixed, not vehicle-actuated. The intersection is one of the busiest in Stuttgart—the approach roads are handling up to 29,000; 25,000; 9,000; 20,000; and 30,000 vehicles per day of 24 hours. The peak flows are of the order of: 2,600; 2,500; 900; 1,800; and 2,700 vehicles per hour.

The first section of the City Ring System was completed at the Main Station in 1955. Although the

intersection is constructed at grade it is planned so that at a later date an overpass can be incorporated.

Note in Fig. 4 the well defined and marked lanes, directional arrows, pedestrian 'Zebras' with very wide widths marking the crossings, pedestrian signals, and lighting arrangements, also the well organized car park—now fitted with parking meters.

The practice of turning off signals at night and on holidays is not recommended. Evening and early morning hours can be especially accident prone. It is not clear who has the right of way. In the United States it has been found that the best practice was to put the signals on 'blink' when the normal signal cycle was no longer justified. 'Blinking-amber' was used for the main route, denoting 'proceed with care', and 'blinking-red', denoting 'stop, and proceed with caution' for the minor route.

The Wagenburg Tunnel was the first long urban motor tunnel to be built in West Germany, and was opened for traffic in Stuttgart in March 1959. Tunnelling operations started in early 1941, and during the war the tunnel was used as an air raid shelter. It is nine hundred yards long and at present carries a single line of traffic in each direction in the first tube. A second tube has been started at the south end and at present is used as a bulk wine store. The tunnel rises 144 feet from the south end through the hill climbing at 5.73 per cent for 600 yards and the remainder at 5.42 per cent. At the deepest point it is about 150 feet below the surface. With a full load of traffic 13,000 cubic feet per second of fresh air are pumped through the tunnel with an average velocity of 40 feet per second on the fresh air duct. The normal range is from 1,600 cubic feet per second to 6,500 cubic per second. For two main journeys in the city the distance has been shortened by 550 and 765 yards respectively.

The tunnel is at present handling approximately 26,000 vehicles per day, and 1,800 at the peak hour—combined flow in both directions.

The Paulinen Strasse overhead road on the south side of the City shopping centre is planned as two bridges, side by side, of which the northern one has been completed. Each bridge will carry two lanes of traffic. This bridge road is attractively designed in reinforced concrete and fits in admirably with adjoining property, and actually creates an agreeable view when driving in or out of the City on the Tuebinger Strasse. The carriageway is approximately 30 feet wide, accommodating three lanes of 10 feet each: two lanes on the down grade and one on the up grade are the lane arrangements on the first bridge recently opened.

Future Traffic Needs

Stuttgart ranks seventh in Western Germany in degree of motorization (144 vehicles per 1,000 population), and this is increasing at the rate of approximately 10 per cent per annum. It has been estimated that saturation in Stuttgart will be reached when one person in every three owns a vehicle. In January 1960 there were 110,000 vehicle registrations in Stuttgart which makes the present average vehicle ownership one in six.

The problem is to forecast accurately the needed street capacity for the future, and arrive at an economical programme which will not require too much modification or reconstruction in the near future. Certain basic assumptions must be made about traffic and parking. How far into the centre should main circulation arteries come? Can high volume interchanges in the central areas be catered for? Was it correct for instance to bring the Wagenburg Tunnel through the hill to arrive directly on top of a heavily trafficked route, Neckar Strasse, and lead right into the Main Station square? The normal rule is 'No main routes at stations, but good access!' The first and greatest need, as mentioned earlier—and now in the process of being assembled, is complete and accurate information on current traffic in Stuttgart. Secondly, a long-range, complete and comprehensive traffic plan must be prepared for the Stuttgart Region as a whole with a definite planning date aimed at, initially, 15 to 20 years ahead.

Fig. 5. Botnang Saddle Overpass.

Stuttgart is typical of many cities where there are political conflicts of one sort or another which affect town and traffic planning. Here the Land not only carries its highway system up to the City boundaries but also owns a good deal of property inside the City which affects traffic and town planning proposals. The authority for town planning is vested in the City. These two factors have created a difficult relationship between Land and City. In the past there has been insufficient co-ordination between the City authorities and the Land on proposed project plans. The normal procedure has been to present project plans to the Land without any prior consultation. From this arises unnecessary conflict. Part of this is tied up with personality problems and general public relations. At a recent meeting in the Rathaus (Town Hall) where both Land and City were represented, the Mayor very tactfully called for coffee, tea, and cakes to cool the atmosphere. This sort of problem is in fact one of the most important aspects of getting the technical work of the traffic engineer into practice and the service of the public. It affects economy of City, Region, and Land. Ideally there should be a close understanding between the two authorities on policy, and teamwork on projects that affect each other.

Although there are problems and shortcomings to be seen in the present-day picture of Stuttgart traffic

(*Concluded on page* 221)

Advantages of

TRAFFIC SIGNAL CONTROL

by B. D. Richardson

Lecturer in Highway and Traffic Engineering University of Birmingham

AT a simple uncontrolled four-legged intersection of two roads, there exist thirty-two points of conflict, half of which are crossing conflicts with the highest accident potential. At these thirty-two points there can arise conflicting demands for priority and, when a conflict does occur, one vehicle or the other has to give way if an accident is to be avoided. If the same intersection is controlled by traffic signals allocating alternatively the right of way to each of the two roads, the number of possible points of conflict is reduced to eight, of which only two are crossing conflicts. (*See Fig.* 1 *below*).

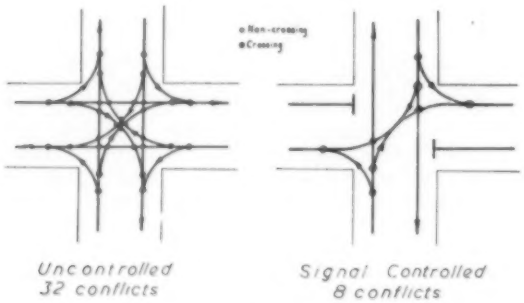


Fig. 1. *Conflict Points at Intersections.*

It can be seen that in so controlling the intersection the reduction in the number of points of conflict decreases the accident potential and it is obvious that when the volumes of traffic handled by the intersection are high, causing conflicting demands to arise continually, this reduction in accident potential is important.

Further, of the thirty-two points at an uncontrolled intersection, in twenty-four of them the 'interfering' vehicle demands a gap of appreciable duration in the opposing traffic stream in order that the conflict may be safely resolved. As volumes of traffic flow increase, these gaps occur less and less frequently until eventually traffic is brought to a standstill by the choking of the intersection with waiting vehicles.

Only four such 'gap demanding' conflicts arise in a normal two phase signal controlled intersection and these may be reduced or eliminated by simple alterations to the phasing.

Finally, in this comparison, there is the effect of marshalling traffic before passing it through the intersection. As has been said, increasing traffic flows result in less gaps between vehicles which are sufficiently long for crossing and merging manoeuvres and yet, at the same time, many of the gaps which are not acceptable for such manoeuvres are still longer than is necessary for a safe headway. If, by 'squeezing up' the vehicles in the traffic stream so that they adopt shorter but still safe headways, then the time so saved becomes available for the necessary crossing and merging operations.

The use of traffic signals is not, of course, the only alternative to a simple uncontrolled intersection. Both grade separation of conflicting flows and the use of a gyratory system, when properly designed, have the advantage of providing uninterrupted traffic flow, but it is clear that a large proportion of the existing road system will have to continue with less expensive adjuncts, and it is in this context that traffic signal systems are, and will continue to be, an invaluable aid to easing traffic congestion.

The foregoing, then, forms a basis for the justification of traffic lights. By decreasing the possibility of accidents, by increasing the capacity of an intersection and by decreasing the overall delay experienced by traffic using the intersection and, by doing this with a comparatively moderate expenditure, traffic signals can result in a high return for the money invested.

Characteristics of a Signal Controlled Intersection

Fig. 2 shows the distance/time diagram for a stream of vehicles approaching and passing a signal controlled intersection. Assuming there has been no extraneous interference, times of arrival of each

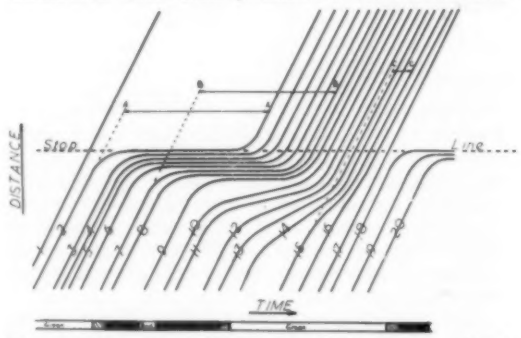


Fig. 2. *Distance/time diagram for vehicles passing signal controlled intersection.*

vehicle within the zone of influence of the intersection will be randomly distributed (Adams, W. F., Road Traffic Considered as a Random Series. J. Inst. Civ. Eng. 1936. 374 (1) p. 121-30) and the headways will be distributed accordingly. Vehicle number 1 approaches the intersection with a green aspect and proceeds straight through the intersection unchecked and without delay. Vehicle number 2, however, receives an amber aspect and accordingly slows down and stops on the line with vehicles 3 to 9 likewise slowing down and stopping in queue formation behind him. Vehicles 10, 11 and 12 slow down preparatory to stopping but, before coming to rest, receive the succeeding green aspect and are able to accelerate away. Vehicles 13 to 16, although having a green aspect, are forced to slow down due to the interference of the vehicles ahead but do not have to stop. Vehicle 17 proceeds through the intersection without interruption.

TABLE 1
Average Minimum Headway from Queue Formation

Vehicle position in queue	*Average minimum headway, sec.*
1st	3.8
2nd	3.1
3rd	2.7
4th	2.4
5th	2.2
6th	2.1

(*B.D. Greenshields et al., Traffic Performance at Urban Street Intersections, Yale University, Bureau of Highway Traffic, Technical Report* 1, 1947).

In Table 1 above are shown the average headways developed when a queue of cars is released at a stop line. These headways are somewhat larger with the slower moving vehicles but the pattern is much the same. By virtue of anticipation, vehicles further back in the queue are able to, and do, adopt shorter and shorter headways until by the sixth vehicle the headways are fairly standardized at around the two second mark. The result is that although headways on arrival at the intersection may vary between two and, say, twenty seconds, upon departure they are reduced to about two seconds with the consequence that the vehicles in our sample are 'squeezed up' into half the distance they previously occupied and are able to pass a given spot in half the time. The other half of the time is then available for the crossing traffic stream to pass through the intersection. Whereas the arrival headways in our example were insufficiently long to permit crossing manoeuvres by the crossing stream of traffic, they were, on the average, longer than was necessary for safe driving. This time, surplus to safety requirements, has been taken out by the action of the signals and made available as a continuous period for the crossing traffic.

This effect, of course, has not been achieved without approaching vehicles incurring a measure of delay. Vehicle number 2 is delayed the most, the actual delay being represented by AA along the time scale while succeeding vehicles incur shorter delays; BB for vehicle number 7, CC for number 15 and no delay for number 17.

From what has already been said concerning the increased headways adopted by slower moving vehicles when drawing away from the stop line, it can readily be seen that with greater numbers of such slower moving vehicles in the approaching traffic stream, the amount of traffic that can be discharged during a green period will be decreased. Also, there is the effect of right turning vehicles. Unless special provision is made for right turners, they have to wait for suitable gaps in the traffic stream approaching from the opposite direction before they can clear the intersection. This waiting delays to a greater or lesser extent the traffic behind them, again reducing the number of vehicles discharged during a green period.

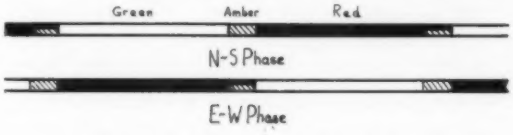


Fig. 3. Aspects shown in simple two-phase signal system.

Delay at Intersections

A simple two-phase signal system presents aspects as shown in Fig. 3 above. Considering one of the legs of the intersection, the rate of discharge from the stop line will be as indicated in Fig. 4 below, where it will be seen that vehicles start to move on the receipt of the green aspect, building up to a maximum rate of discharge referred to as the saturation flow, and then on termination of the green aspect, the rate of discharge falls to zero. The area under the curve represents the total number of vehicles discharged. If this total number is divided by the saturation flow, the resulting figure is the effective green time. This time, although in general greater than the green period, is less than the green plus amber period. The amount it is less, is time lost to the intersection since it is not effectively used by either phase for the purpose of passing traffic.

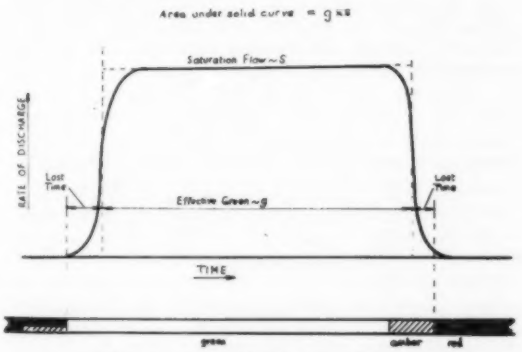


Fig. 4. Rate of discharge for fully saturated green period.

This lost time, which represents the effects of acceleration and deceleration, occurs on each change of phase together with any loss of time due to red or red/amber aspects showing simultaneously on all phases. Accordingly, the longer the cycle, the less changes of phase per hour and hence less lost time per hour and the more time available for the passing of vehicles. It can be seen, therefore, in the extreme

case, if each phase had respectively twelve continuous hours of green, the lost time would be negligible and the capacity of the intersection at its highest. Such an inordinately long cycle would, of course, lead to impossible delays, and even at the expense of incurring more lost time, the cycle time must be reduced to tolerable proportions usually somewhat less than two minutes.

Factors Affecting Delay

Gathering together all the factors affecting delay at a signal controlled intersection, we have :

(*a*) The total number of vehicles which can be discharged each cycle which is a function of the effective green time per leg per cycle and of the saturation flow.

(*b*) The cycle time.

(*c*) The volume of approaching traffic.

Webster has shown (Webster F. V., Traffic Signals Settings, D.S.I.R. Road Research Technical Paper number 39.) that delay can be expressed by the equation:

$$\frac{c(1-\lambda)^2}{2(1-\lambda x)} + \frac{x^2}{2q(1-x)} - 0.65\left(\frac{c}{q^2}\right)^{1/3} x^{(2+5\lambda)}$$

Where d = average delay per vehicle on any particular leg of the intersection being considered,
c = cycle time,
λ = proportion of cycle which is effectively green on the phase under consideration,
q = flow on the particular leg,
s = saturation flow of the particular leg,

$x = \text{degree of saturation } \left(\frac{q}{\lambda s}\right)$ on the particular leg, the same units of time being used throughout.

And this expression for delay incorporates, in one form or another, factors (a), (b) and (c) listed above.

Optimum Cycle Time

The total delay on each leg is the average delay on each leg multiplied by the flow on that leg and the overall delay D experienced at the intersection as a whole is the sum of the delays at each leg, i.e.

$$D = \Sigma d \times \text{flow}$$

By expanding and differentiating this expression with respect to the cycle time Webster has shown (op. cit.) that for minimum overall delay the cycle time can be represented by:

$$c_o = \frac{1.5\,L + 5}{1 - Y}$$

where c_o = the optimum cycle time for the intersection,
L = total lost time per cycle in seconds,
Y = the sum of the y values where the y value is the maximum ratio of flow to saturation flow, $\frac{q}{s}$, for each phase.

The total lost time L is made up of deceleration and acceleration delays and of time lost due to 'all red' periods (i.e. a period when red aspects show simultaneously on all phases) together with time lost due to the simultaneous showing of red and red/amber aspects. This 'all red' device is used, when traffic conditions warrant it, to permit pedestrians to cross and vehicles, particularly right turning vehicles, to clear the intersection.

Y, in the expression, is the sum of maximum ratio of flow to saturation flow $\left(\frac{q}{s}\right)$ for each phase.

The saturation flow, s, for each leg, is governed by the width of road available for traffic to pass and by the composition of the traffic stream being decreased by increasing numbers of heavy vehicles and right turning traffic. The flow, q, is the average rate of arrival of vehicles on a leg.

Hence it can be seen that for a given intersection, the main possible variables affecting the expression for optimum cycle time are; (a) volume, (b) pedestrian requirements and (c) changing composition of the traffic stream. Larger volumes demand longer cycle times. Greater pedestrian movements necessitate a longer 'all red' period and, hence, longer cycle time. An increase in the number of slow or right turning vehicles by decreasing the saturation flow also necessitates a longer cycle time.

Compromise Cycle Time

One or more of these variables will indeed vary during the course of a day at the average intersection, and each new set of circumstances will demand its own cycle time.

With vehicle actuated traffic signals, which will be the subject of a later article, the action of the traffic on the detection pads can be made to vary the cycle time to a value suitable for the circumstances prevailing. With fixed time signals, however, it is necessary that a compromise cycle time be chosen so that the varying demands of the traffic can be satisfied with one signal setting without undue delay being caused.

It has been found that for most practical cases the effect of using a cycle time within range of $\frac{3}{4}$ to $1\frac{1}{2}$ times the optimum cycle time is such that the average delay to vehicles is not increased by more than 10 to 20 per cent over the delay experienced in the optimum cycle. (Webster, op. cit.). Accordingly, when cycle time demands vary, and it is desired to use a single setting, the following procedure can be adopted in choosing a compromise cycle:

(*a*) Calculate optimum cycle times for each hour of the day when traffic volumes are heavy or medium and take the average of these cycle times.

(*b*) Calculate optimum cycle time for the heaviest peak hour.

(*c*) Use, as compromise cycle time, either the average calculated under (*a*) above or $\frac{3}{4}$ of the optimum calculated under (*b*) whichever is the longer.

The use of this device is shown in the example where the conditions at a junction are considered.

Allocation of Green Time

Once a suitable cycle time has been decided, it is necessary to allocate green time to each of the phases. This problem is best approached by considering the degree of saturation on each leg.

If a particular leg has a saturation flow of s and if the proportion of time which is effectively green to that leg each cycle is λ then the maximum number of vehicles that can pass the intersection from this approach is λs. If the approaching traffic volume is q, the degree of saturation $x = \frac{q}{\lambda s}$ i.e. the ratio of actual flow to maximum possible flow.

In deciding the signal setting it would seem logical, all things being equal, that the degree of saturation on each leg should be made the same. Accordingly, if we consider an intersection with a north-south phase and an east-west phase then we should make:

$$x_N = x_{EW}$$

i.e. $$\frac{q_{NS}}{\lambda_{NS}\ s_{NS}} = \frac{q_{EW}}{\lambda_{EW}\ s_{EW}}$$

or $$\frac{\lambda_{EW}}{\lambda_{NS}} = \frac{q_{EW}}{s_{EW}} \cdot \frac{s_{NS}}{q_{NS}}$$

For each phase there may be more than one value of the $\frac{q}{s}$ type of term since there may be more than one approach on each phase. In this event the greatest value is taken. That is, the maximum $\frac{q}{s}$ value is taken which has previously been referred to as the y value.

Accordingly, $\frac{\lambda_{EW}}{\lambda_{NS}} = \frac{y_{EW}}{y_{NS}}$ or, to put it into words, the available effective green time is divided between the phases in the ratio of their y values and this can be done for two, three or more phases.

Allocating a proportion of green time to each phase in this manner results in a similar degree of saturation for each phase. Where the y values vary throughout the day due to changing traffic conditions the allocation of green time is best done in proportion to the average y values for the peak periods.

Table II gives hourly counts of traffic approaching a four legged intersection controlled by a two phase fixed time signal. The subsequent calculations show the approach to the problem of determining the necessary signal settings.

The saturation flow was determined by averaging over a representative time the number of vehicles discharged each fully saturated green period and dividing the number by the effective green time assumed to be two seconds less than the green plus amber time.

To accommodate pedestrian movements a three second 'all red' period is allowed on each change of phase.

TABLE II

Time of Day	Number of Vehicles Counted			
	South Bound	North Bound	West Bound	East Bound
7 a.m.-8 a.m.	395	585	435	465
8 a.m.-9 a.m.	475	850	800	585
9 a.m.-10 a.m.	510	710	585	410
10 a.m.-11 a.m.	500	540	425	310
11 a.m.-12 noon	560	530	290	260
12 noon-1 p.m.	520	550	385	310
1 p.m.-2 p.m.	420	540	300	340
2 p.m.-3 p.m.	440	620	360	300
3 p.m.-4 p.m.	635	650	400	350
4 p.m.-5 p.m.	670	670	425	385
5 p.m.-6 p.m.	830	790	520	620
6 p.m.-7 p.m.	595	500	340	310
Saturation flow Vehicles/hour.	2,600	3,000	2,250	1,800

TRAFFIC PLANNING—STUTTGART

(*Concluded from page* 217)

there is no adequate reason why these cannot be solved rapidly and competently. So long as the necessary broad approach is adopted for comprehensive town and traffic planning, backed up by the needed fundamental statistics and data, which must be collected and made available, there is every chance that Stuttgart can remain a prosperous and successful city for the future. The future planning programme must be reasonably flexible in approach and subject to constant review to take account of new techniques, the rapid growth of motorization, and unforeseen transportation trends in conjunction with town planning demands. Cities such as Stuttgart should not hesitate to call in the aid of experienced consultants to assist in solving planning and traffic problems. However fine are the traffic and town planning permanent staffs, they are constantly bogged down with day-to-day problems and because they are so much 'on-top-of-it' all the time it is often extremely difficult for them to see the overall context without being prejudiced. Fortunately, Stuttgart seems to be aware of this and has readily taken advantage of the skills available at the Technical University here and of consultants. For example, between 1946 and 1957 the city employed four such consultants on different projects and studies. For a comparative city in England we can look at Sheffield, which is about the same size and also a 'valley-bowl' city. But Sheffield has a tangle of a communication network and no reliable information on which to base sound traffic planning.

Questions which remain unanswered about Stuttgart are first, from the town planning point of view: has the Development Plan of 1956 been kept sufficiently up to date and reviewed; and is the policy of developing new housing estates on the outskirts of the city correct, relying as it does on extended tram routes to serve them? The residents will have to travel considerable distances over existing routes which are already heavily loaded. The journey to work problem is rendered even more acute because no industry is planned to link up with these estates. Second, from the traffic planning point of view traffic projects should not be attempted until a full and comprehensive traffic analysis is available together with a sound and forward looking plan for the future. Therefore is it advisable that Stuttgart should proceed further with building projects before this confirmatory or contradictory information is available? Also, is the Land justified in its attempt to influence town and traffic planning policy in the City, and would it be advisable for the Land to call in a traffic consultant?

Acknowledgment

The author wishes to express his acknowledgment and thanks to officers of the City of Stuttgart who have assisted him in the collection of material.

Modern Lighting U.S.A.

MODERN lighting is one of the noteworthy design features of the new Miami Beach, 36th Street Causeway, recently opened to traffic in the Florida metropolis, and because this is an example of up-to-date street lighting employed in the United States, the following details are given:

The end-to-end length of the lighted project is 2.98 miles, of which 3,958 linear ft. is bridge structure. This 2.98 miles, end-to-end, does not include the approximately two miles of additional lanes, ramps, etc. which constitute the Interchange on the Miami Beach side. These lanes are also lighted.

The design intensity is for approximately 0.9 lumen per square foot, maintained. The luminaries are end-mounted (2-in. adjustable fitter) aluminium, with 400-watt, colour improved lamps. The ballasts are of the regulated output type, with operation of 400 to 520 volts.

The light poles are transformer base type. The shafts are round-spun aluminium, tapered from 8 in. to 4 in. and with 0.188 in. wall thickness.

On roadway sections the posts are mounted on pre-cast concrete bases, of a tapered design. Bracket arms are 12 ft. long tapered aluminium, with elliptical cross section. On bridges the pole bases were poured monolithically with the superstructure in the handrail line. Roadway poles are set 11 ft. from edge of pavement (3 ft. from edge of paved shoulder). Bracket arms are 6 ft. long tapered aluminium. Bridge poles are spaced at about 125 ft. staggered. Roadway poles are staggered at approximately 130 ft. spacing on either side.

The power centres for the system were installed by the contractors—one at the west end of the westerly main bridge and the other near the load centre of the Miami Beach Interchange. In lieu of the conventional fence-type enclosures, the power centres, for aesthetic reasons, are enclosed by open top, concrete block walls. The switching on the high-voltage side of the power centres, transformers and high-voltage equipment was furnished by the Florida Power and Light Company. The power is brought in at 13 KV, and the lighting circuits are 480-volt multiple.

Conductors for power service consist of one 15 KV, No. 4 paper-insulated, lead covered, with a protective neoprene jacket and one 600-volt, No. 4 neoprene-jacketed, Style RR neutral. Conductors for the lighting circuits are direct-burial, 600-volt, Style RR, neoprene-jacketed.

On the bridges these conductors are of copper, but on the roadway sections the contractor was permitted to use aluminium of appropriately larger size.

The 15 KV lines for power service are installed in 3-in. asbestos fibre ducts encased in concrete to a minimum of 3 in. cover. Manholes are spaced at approximately 500 ft. The lighting circuits on the bridges and for cross-unders under paved areas are installed in high-impact, schedule 40, polyvinyl chloride conduit.

Grounding of light poles and associated metal parts on roadway sections is by Copperweld, ⅝-in. by 8 ft., driven 6 in. below ground. On the bridges the grounding is accomplished by a No. 4 bare conductor, connected to driven grounds and the system ground at the ends of the bridges.

Street Lighting Study

A study has been initiated by the Ohio State University Research Foundation under the sponsorship of the Illuminating Engineering Research Institute of New York, to determine the effectiveness of various roadway lighting systems for use in clear weather and in fog.

Field measurements have been made in clear weather on roadways in five Ohio cities and at a special test facility in North Carolina. The measure of effectiveness of each roadway lighting installation was the extent to which various realistic objects were visible down the roadway. A mannequin and two stuffed dogs were among objects studied. Incandescent, mercury, and fluorescent light sources were studied. The effects of varying the spacing between luminaries and of using different pavement surfaces were examined. Instrumentation included a device to measure the visibility of objects under different lighting conditions, and a device to assess the 'glare' produced by each lighting system. The results not only reveal the relative effectiveness of the various lighting systems under different conditions, but also establish the illumination required to provide sufficient visibility to reduce pedestrian accidents under different roadway conditions.

Since it is difficult to obtain outdoor fog with sufficient regularity for scientific purposes, the studies of roadway lighting in fog were conducted in a 1 to 10 model scale simulator. Controllable artificial fog was produced by mixing water vapour and compressed air. Scale model vehicles, roadway lights, and a roadway marking were used. Measurements were made of the distances at which a stopped vehicle was just visible, when the roadway was lighted with various experimental systems. Several systems were found which were considerably more effective in fog than the systems normally used in clear weather, these systems operating on the principle that as little as possible of the fog between the eye and the stopped vehicle should be lighted.

LIGHTING CONFERENCE

The Association of Public Lighting Engineers is to hold its Annual Conference at Folkestone from September 13-16.

The Preliminary Programme is as follows:—

SEPTEMBER 13

10.00 a.m. **Official Welcome and Opening of Conference**
by His Worship the Mayor of Folkestone.

10.15 a.m. **Induction of President,**
Mr. F. C. Smith, M.B.E., F.C.S., M.Inst. Gas.E., F.I.E.S.

10.30 a.m. **Presidential Address**
by Mr. F. C. Smith.

11.15 a.m. **Opening and Inspection of Exhibition and Outdoor Displays of Street Lighting Apparatus and Equipment,**
by His Worship the Mayor of Folkestone in company with the President and members of Council.

3.00 p.m. **Conference Session:**
Paper—An Engineer Surveys the Changing Scene, by Mr. Curzon Harper, B.Sc., M.I.C.E., M.I.Mun.E.

8.30 p.m. **Civic Reception**
by The Mayor and Mayoress of Folkestone. (Dancing 9 p.m. to midnight. Refreshments and Cabaret).

SEPTEMBER 14

10.00 a.m. **Conference Session:**
Inspection of Exhibition and Outdoor Displays of Street Lighting Apparatus and Equipment by members and delegates (Representatives of exhibitors will be available to deal with questions).

11.15 a.m. **Conference Session:**
Open Forum—Short free discussion on municipal matters relating to Street Lighting (A small platform party will be available to deal with questions).

12.30 p.m. **Annual Luncheon.**

SEPTEMBER 15

10.00 a.m. **Conference Session:**
Paper—The Contribution of Advances in the Technologies to Public Lighting, by Mr. J. G. Holmes, D.I.C., B.Sc., F.Inst.P., F.I.E.S.

3.00 p.m. **Conference Session:**
Paper—Some recent studies of the Lighting of Traffic Routes, by Mr. J. M. Waldram, B.Sc., A.M.I.E.E., A.C.G.I., F.Inst.P., F.I.E.S.

8.30 p.m. **Reception**
by the President, Mr. F. C. Smith, M.B.E. (Dancing 9 p.m. to midnight. Refreshments—Cabaret).

SEPTEMBER 16

10.00 a.m. **Conference Session:**
Paper—Progressive Changes in Public lighting, by Mr. T. M. Lappin, F.I.E.S., and Mr. H. Robertson, Grad.I.E.E.

11.45 a.m. The President to address the meeting and the Mayor of Folkestone will terminate the proceedings.

A full report of the Conference will be published in the October issue of Traffic Engineering and Control.

HARD SHOULDER PARKING

A LORRY was parked on the hard shoulder of the London-Birmingham Motorway M1 and observations were made by the Road Research Laboratory on the position reached by its driver when stepping down from the cab. For the purpose on the experiment, which was carried out on a section of the Motorway near Aldenham, Herts., before it was opened to traffic, the shoulder, which had a nominal width of 8 ft. was extended by the use of steel mesh track to 10 ft. and then to 12 ft. Only with the 12 ft. width was the driver able to park so that he could remain entirely on the shoulder when he got out: on the narrower widths he stepped down either on the the white edge marking (1 ft. 6 in.) or on to the carriageway.

Experimental Procedure

The study was made on an unopened section of M1, between Waterdale (A405 junction) and Aldenham Terminal (A41). The carriageway at this point had two lanes 11 ft. 6 in. wide with an additional 1 ft. 6 in. wide white edge-marking defining each edge of the carriageway. There was a hard shoulder of 8 ft. nominal width made of lean concrete 5 in. thick. For the experiment additional shoulder width was provided from portable steel mesh track.

The vehicle used was an A.E.C. 'Mercury' open lorry with an unladen weight of about 3½ tons, and a nominal overall width of 7 ft. 2½ in.

Three shoulder widths were used—8 ft. (as provided on the London-Yorkshire motorway, M1), 10 ft. and 12 ft. The edge of the shoulder was defined by conical rubber markers. These and the portable metal track are shown in Fig. 1.

On each width of shoulder the driver was instructed to position the lorry centrally on the shoulder and photographs were taken in which the driver was shown with one foot on the ground as he dismounted from the cab of the lorry. This was repeated for each width of shoulder with the lorry positioned by the driver as he would do normally.

Results

The vehicle parked centrally on the 8 ft., 10 ft. and 12 ft. shoulders is shown in Figs. 1, 2 and 3.

Only on the 12 ft. wide shoulder was the driver able to dismount from the lorry and remain entirely on the shoulder. With the 10 ft. wide shoulder the driver was well onto the 1 ft. 6 in. wide edge marking, while when the lorry was on the 8 ft. wide shoulder the driver dismounted onto the nearside lane of the carriageway. A similar result was obtained in the tests where the driver selected his own position, although he did not select the central position in which to park.

Conclusions

From these results it is thought that unless the lorry is positioned on the shoulder with some care it is likely that the driver would dismount onto the carriageway or edge marking whenever the width of the shoulder was 10 ft. or less.

The work described in this article was carried out as part of the programme of the Road Research Board of the Department of Scientific and Industrial Research. The article is published by permission of the Director of Road Research.

NEW PUBLICATIONS

Dictionary of Highway Traffic, by J. Stannard Baker and William R. Stebbins, Jr., Traffic Institute, Northwestern University. $6.

A dictionary of highway traffic terminology was published in June by the Traffic Institute, Northwestern University, Evanston, Illinois.

The book systematically shows the differences and similarities among terms currently used in the various fields related to highway traffic and safety.

Its main purpose is to improve communication among technical and specialized groups in the road traffic field. The scope of the dictionary is limited essentially to the most usual technical language. For example, distinctions are drawn between such terms as 'junction' and 'intersection', 'registration' and 'licensing', and 'supervision', 'control' and 'direction'.

Bulletin No. 240. Highway Research Board, Washington. $1.

This bulletin contains papers presented at the 38th Annual Meeting of the Highway Research Board.

'Statistical Determination of Effect of Paved Shoulder Width on Traffic Accident Frequency', by R. C. Blensly and J. A. Head, reports on research by the Oregon State Highway Department in the use of statistics to analyse the difference between the average accident frequency on sections with narrow paved shoulders (4 ft. or less) and on sections with wide paved shoulders.

'Factor Analysis of Roadway and Accident Data', by John Versace, is a further analysis of data presented by Schoppert in 1956, seeking to make apparent additional relationships among the roadway features while compressing the results into a small number of more universal motions.

Fig. 1. 8 ft. shoulder.

Fig. 2. 10 ft. shoulder.

Fig. 3. 12 ft. shoulder.

ROAD SAFETY

IN SEARCH OF TRAFFIC SAFETY

by J. A. Lain

Statistical Officer, RoSPA

THE problem of road accidents and how to prevent them is common to almost every country in the world. There was a problem with the coming of the first vehicle a lifetime ago, but it has grown like some fantastic creature in a horror film. At first no one was particularly concerned, but after a few years some more observant, realistic, perhaps pessimistic types became awake to the situation and foresaw what might happen if we became a nation of mechanical road users.

We have, and now with a population of more than 50 million there are 190,000 miles of road, and nine million vehicles using them: five million cars, nearly two million motor cycles, scooters and mopeds, well over a million vans and lorries . . . . That is the position on the roads today and it is not a comfortable one. Road traffic claustrophobia is a common complaint. You do not have to be driving or riding to sense congestion. Even pedestrians feel it. When we first resorted to mechanical road transport there was plenty of room. One could set out on a formidable journey on a sunny weekend and not expect to encounter much traffic. But now at peak periods there is insufficient space for your exhaust to escape. If you are fortunate enough to find a place to park in the morning, you may not be so lucky in finding a way out in the evening.

Statistics of Growth

Just how has all this come about? In 1910 there were 144,000 vehicles, less than one per mile of road; in 1920 650,000 vehicles, about four per mile, and by 1930 2,274,000 vehicles, 13 per mile. At the outbreak of war 3,149,000 vehicles were licensed, 18 per mile. By 1950 there were 4,414,000 vehicles, 24 per mile and, this year, with nine million vehicles, there will be 47 for each mile of road.

One cannot say exactly how many casualties there have been on the roads this century. But one can estimate sufficiently accurately to assess the magnitude of the problem. In round figures there were about 8½ million victims in the first 59 years of the 20th century with 255,000 killed on the roads. With the growth of traffic there has been a growing number of killed and injured. The last five years have been the blackest in the history of British roads, and 1959 was by far the worst. 333,453 casualties in 261,216 accidents. Deaths, 6,520; seriously injured, 80,672. Never before had 300,000 people been killed or injured on the roads in a year. 51,688 of the victims were children under 15 and never before had their casualties exceeded 50,000 in one year. In a year total casualties now average eighteen killed a day, and 896 injured. That is a death every 81 minutes and an injury every 96 seconds. Of the total of 333,453 casualties, 89,738 were passengers, 78,229 riders of motor cycles, scooters or mopeds, 67,680 pedestrians, 52,070 pedal cyclists and 45,736 were drivers. The death total of 6,520 was the highest since the early part of the war. Of these, 2,520 were walkers, 1,384 riders, 1,148 passengers, 738 cyclists and 730 drivers. Figures for the first few months of 1960 indicate that, if the present trend continues, 1960 will be the worst year yet. There could be over 360,000 casualties this year and 7,500 deaths.

What has been done, what is being done, what is going to be done to reduce road accidents, to promote safety by all road users? Much has been done, much more is being done and will be done while the toll of the roads is still so high. At the hub of many road safety organizations throughout the nation is RoSPA (The Royal Society for the Prevention of Accidents). It recognizes that accidents can be prevented by the three E's of road safety; Engineering, Enforcement, Education. Not one of these is sufficient in itself without the others. Our roads today generally are not adequate to accommodate nine million motor vehicles, as many pedal cycles and 50 million pedestrians. New roads, motorways, improvements in general are being built faster than ever before. We are trying to catch up from the engineering angle, but it is inevitably a slow process —the problem of crowded roads is here for many years yet.

Other aspects of Engineering of interest to the safety specialist include the following: discreet use of street furniture is a considerable aid to safety; too much or too little can be unrealistic. Road signs should be clear, well-placed and uniform in design. Each outlet at a roundabout should be clearly labelled. Ambiguity must be eliminated. Similarly, street lighting should, in the interests of safety, be uniform and adequate. Insufficient and inconsistent lighting can be hazardous. Lamp-posts etc. made of rubber or plastic material, provided they were weather and wear-proof, would clearly help to reduce the chance of severe injury in the event of an accident, but at the same time would surely tend to develop disrespect and lack of fear of hitting them. Reflective materials can also help the cause of safety. RoSPA encourages their use by pedestrians (particularly the old and the young), cyclists and other vehicle users and also in the illumination of road signs.

The effect of installing safety kerbs to prevent vehicles leaving the highway at dangerous bends has been studied, and it was deduced that personal-injury accidents were reduced by 60 per cent. Decidedly a boon to the driver who goes too fast at corners.

Safety helmets are surely a must for all riders and their passengers. Their value in reducing accidental head injuries is undisputed, and it is not surprising that their popularity has increased enormously of recent years.

Safety belts for drivers have potential value as a safety aid, and an official standard is shortly to be issued by the British Standards Institution.

There must be strict enforcement. There will, unfortunately, always be the criminal of the road. He is a menace to us all, as well as to himself. The government and the police, who are short-handed, have the task of keeping him down.

The Three E's

RoSPA specializes in the least hampered of the three E's—Education. We are all road users, if only walkers, and as such we must know how to use the roads properly, for to drive or ride on the roads is a privilege, not a right, and we must respect the roads and all other road users accordingly. We should get to know the Highway Code. Its rules are simple, its message essential. Without knowledge of it we become criminals of the road. We can all be good road users, and we must do so if the ever-rising trend of accidents, deaths and injuries is to be stopped.

More, bigger and better roads we must have, and will have, and then our lives on the road will be more enjoyable. We need more room to park—off-street parking is the friend of road safety. More off-street training grounds are also needed because the highway is no place for the novice. But first and foremost we must all educate ourselves to be social road users, i.e. to respect all our colleagues on the road. For to be social is to be safe, and to be safe is to be sound and so the prevention of road accidents is the responsibility of all road users and it cannot be shifted on to the shoulders of the Government and the Ministry of Transport.

PROFILE . . .

of a

TOWN PLANNER

Sir WILLIAM HOLFORD

READERS of this journal hardly need an introduction to Sir William Graham Holford, but they may still be surprised at the degree and intensity with which so distinguished an architect as the newly elected President of the Royal Institute of British Architects identifies himself with our aims. To Sir William the necessity of architecture to traffic engineering goes much further than such things as siting of buildings to improve traffic flow, even than the amenities of pedestrian precincts, as in his famous City of London Plan (which he produced with the late C. H. Holden). His conviction is so deep as to be a philosophy. The more mechanized living becomes, he holds, and the more pressure there is on space, on transport, on privacy, or the more strain from noise-making machines, scooters, motor-bicycles, sub-stations, jet planes—the more desperate is the need, not merely for tranquillity, but for the balm of visual beauty. This is no starry-eyed, vague ideal, but an urgent practical necessity.

A hundred and fifty years ago, he argues, the British Isles formed a wonderful background for a population of twenty million. For fifty million they are becoming well nigh impossible, unless we act in time to preserve the unique quality of this country, in which the whole landscape is a garden. People too easily become accustomed to ugliness, to stress, to living on the by-pass . . . traffic roaring past, unsightly wires overhead; while in our cities, buildings like mammoth filing cabinets reflect contemporary filing cabinet minds. From the tensions all this sets up, the nervous illness, the sense of futility, we can, however, be saved. The presentation of historic sites and natural beauty, the consideration of shape and colour in building, whether in conformity with the landscape or in bold contrast —the benefit of these things may not be assessed in terms of purchasing power or the balance of imports, yet the psychological gain is of infinite importance. The marriage of art and science is civilization. Architects, however, must realize that buildings have an engineering content; engineers need to appreciate that planning and structure must be taken together from the start, that architects are not mere decorators to be called in 'to stick the icing on the cake'.

The deep sense of social values with which all this is urged has an almost religious quality. Sir William is the grandson of a scholar and missionary and was educated at the Diocesan College, founded by Bishop Grey in Cape Town in 1842. His father, a civil and mining engineer, went out to South Africa to fight in the Boer War, married and settled there.

Brief Apprenticeship

Young William Holford's ambition to be an architect came early, but his father wanted him to have a business training. After he had matriculated, therefore, exceptionally young, he was apprenticed to an accountant. Here he learned two things: business method, for which he has ever since been grateful, and the unshakable fact that he did not want to be a business man. He had taken up water-colour drawing, and dreamed now of being an artist. His father, however, with shrewd perception, saw that his make-up lacked the extravagant element of the genuine painter. He had done well enough in accounting. So why not combine the artistic and practical streaks of his nature in architecture?

It was the young Holford, himself, however, who, seventeen years old, chose Liverpool University, which then had the best architecture school in the world, he maintains. Here he came to study under the aged Charles Reilly—'Prof' to a whole generation of students —and later under Sir Patrick Abercrombie (of the London Plan). Here he learned, besides architecture, how to enjoy the sense-nonsense balance of university life, a balance lost to modern students in today's competition for university places.

This happy sequence, however, was interrupted when his father died and he had to find a job. Friends helped him to go to the United States, where, in nine months, he earned enough to tour the country and return to Liverpool and take his degree, still only twenty-three years of age. He also won the Rome Scholarship for that year, and enlivened his stay in the Eternal City with, among other things, playing Rugby football, once even for Southern Italy.

Within the next three years he had started private practice as an architect in Liverpool, had cut his teeth on small jobs, become Lecturer in History of Architecture at the University, and entered into what he has described as 'an inevitable partnership'. Coinciding with his stay in Italy, was the same year's Rome Scholar in Painting, a young pupil of Sickert's, named Marjorie Brooks, and in 1933 they married.

First Break

Then, in 1935, came not only his first big break, but a significant indicator in his career. The then President of the R.I.B.A. gave William Holford's name to the Commissioners for the Special Areas. They were looking for a young architect, interested in Industrial Planning, one not too set in his ideas, nor too grand to build cheaply the factories that were to attract new industries to replace the lost shipbuilding and steel production of the terrible years of unemployment. So young Holford

(*Continued on page* 228)

1. TRAFFIC VOLUME STUDIES

By F. D. HOBBS

This is the first of a series of articles describing instruments and their use for traffic engineering to be contributed monthly by the Paviors Lecturer in Highway and Traffic Engineering, University of Birmingham. The purpose is to describe the principal types of equipment and functions together with the analysis of the data.

A PRINCIPAL function of traffic engineering is the collection and analysis of data. It is unfortunate that in this country since the war little of this type of study work on a comprehensive scale has been undertaken. This lack of information makes the task of design of new roads and improvement of the existing system very much more difficult particularly in view of the low level of road investment. In these circumstances, it is imperative that road priorities are correctly interpreted, and the amount of money spent should bring the correct degree of benefit from both economy of traffic function and construction costs. Design will then embrace all the factors of user and vehicle characteristics which are essentially studies to be performed by government agencies and specialized research organizations. The normal problems confronting the traffic engineer will concern volume, origin and destination and planning studies for both pedestrian and vehicular traffic. Another group of studies will include spot, journey, running speeds, and the measurement of delay. In addition, and covering the whole field of activity, will be surfacing conditions, lighting, parking, alignment, accidents and traffic control requirements.

It will be seen that the scope and extent of the work is wide but, fortunately, today a great deal of routine work can be accomplished by the use of instruments. As some of the instruments are relatively expensive and would not be used continuously by some of the smaller traffic authorities, it would be desirable that grants be made for bulk purchase of equipment to be held in regional areas. In this way, the equipment would be loaned out for a small hire charge and a service engineer would be responsible for its installation and regular maintenance. The success of any work using instruments is dependent to a large extent on regular inspection and checking together with skilled servicing.

Types of Counters

The purpose of these articles is to describe the principal types of equipment and functions together with the analysis of the data in a suitable form for future use. Data must always be analysed as soon as possible after recording and this fact is as important as the maintenance programme previously mentioned.

Information on the volume of traffic (pedestrian or vehicular) in a given period of time is a basic unit of measurement at a specific location and can be applied to a length of road, footway or intersection for the purpose of recording variations in flow, the distribution of traffic on a road system, trends in highway usage, vehicle-mileage (length of road × vehicle flow, etc.). The results can be used for all types of road planning, congestion and accident studies, and for intersection control, particularly where signal systems are in operation.

The simplest types of equipment, and used generally as auxiliary to manual counts, are mechanical or electrical tally counters and stop watches. These simple devices can be fixed to an observer's board in groups according to the number of class observations required. Batch totals are then recorded at predetermined time intervals on a sheet, and the method reduces the strain of counting and recording continuously in heavy traffic flow conditions. There are a variety of tally counter types available for hand, board or wrist and they are particularly useful for pedestrian studies.

The four types of automatic counter are operated by pneumatic, photo-electric, magnetic loop, or pad detectors. The numerical totals are usually recorded on dials, tapes, or charted with pen recorders. It is essential that the cases be rigid, water and dust proof and have provision for locking and anchoring by chain to street furniture. It is often advisable where the instrument will be used for extended periods at one site to have a timber outer case constructed for additional protection.

In the first type the detector part of the apparatus consists of a rubber tube

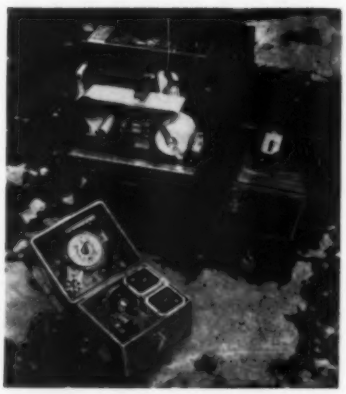
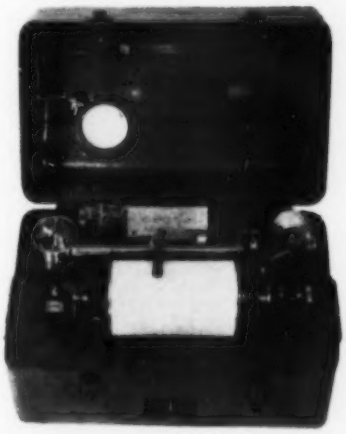


Fig. 1. Three types of pneumatically operated counters. The small counter on the right totals pairs of axles on a dial whilst the small unit in the foreground can be set to count selected periods by inserting plugs and sliding cams on the clock in the lid half. Diaphragm, reading dial and dry batteries are located in the base. The larger counter is a 15 minute printing unit counter with the printing head, eight day clock and roll tape to the fore. Storage battery (6 volt) is located in the base.

set at right angles to the traffic flow and fixed to the road with straps nailed or plugged to the surface. For counts of short duration, the tubes only require anchorage at either side of the road provided that the tension is maintained by a wire securing the rubber tube to the end fasteners and preventing slip. Each axle passing over the tube causes a pulse to operate an air switch. Electromagnets triggered by the switch and energized by batteries actuate a counter which usually records one unit for every two axles. The simplest type is purely an integrator and has to be read at the selected times. More elaborate types use a clock where the mechanism can be set to record volumes for any predetermined period of the day or days of the week. Typical examples could be 8-10 a.m. Monday to Friday or 7-8 p.m. Saturday and Sunday, as long as the required hours of the day are consecutive.

Fig. 2 below is a recording hourly volume counter showing recording drum with stylus, clock upper left and diaphragm right with twin 6-volt accumulators in base.



For complete volumetric analysis, and only requiring a weekly visit to the site, there are counters with printing units recording totals and times in 15 minute or hourly increments on a tape. A further type of pneumatic instrument makes use of a drum chart with the volume record marked in hourly ordinates by a metal stylus on abrasive paper. Counters for use in vehicle actuated signal controllers are also useful. The various types are illustrated in the accompanying photographs.

Figs. 3 below and 4 at top, show the tube fixed by saddle to road and counter by chain to stake and street furniture.

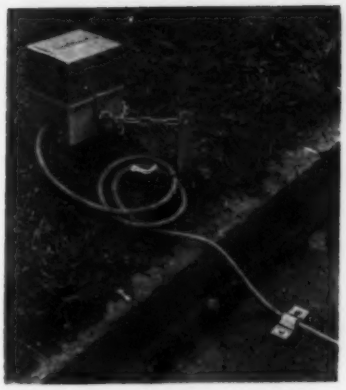


Fig. 4

Photo-electric counters are generally used for long counting periods at permanent stations and there are over 1,000 of these operating in the United States. The apparatus consists of two separate units one containing the light sources and the other the photo cells together with a recorder. Both housings require a normal mains electricity supply. The light sources and photo cells are normally duplicated so that two light beams (filtered so that they are invisible to the eye) must be triggered together for counter operation. This avoids pedestrians upsetting vehicle counts, but on sites where this is not likely to occur a single beam unit can be used requiring mains supply only at the recorder unit which in this case contains both light sources and photo cell. The second housing in this type is solely a small remote reflector unit. A synchronous clock linked to a motor driven printing unit enables hourly totals to be ascertained. A portable battery operated transistorized unit is at present under development at the University of Birmingham and will allow a greater degree of flexibility in operation.

The main defects that occur with automatic counters are associated with either electrical or mechanical failures such as running down of batteries, dirty contacts and punctured road tubes. It is advisable to move the tube transversely across the road at intervals and so even out the wear experienced from repeated wheel passes on the same part of the tube. Small holes can be repaired quite simply and tube life should be in the order of several hundred thousand vehicle passes.

In most traffic studies the classification of vehicle types in the stream will be required and the method employed, using automatic counters, is to sample the flow at selected hours and use conversion factors. These manual counts are in any case a necessary check to be performed regularly to ensure correct instrument operation and hence require little or no additional work.

The first task of the traffic engineer in an area is to establish flow maps showing the average daily traffic on the main routes. This can be undertaken by selecting sites near important intersections and installing a counter for at least a week before moving to the next site. The procedure is repeated until the main routes have been covered and bands, representing to a suitable scale the flow volumes, can then be plotted on the line of existing routes shown on a suitable scale O.S. sheet. The information will of course only be an approximation of the average daily volume due to seasonal influences and the next stages will be directed to increasing the accuracy by setting up full time counting stations at key points on the system. If this is not possible, the seven-day count periods should be repeated six months later at the original sites and then three monthly.

The information now required, and particularly for design purposes at specific locations, will be hourly, daily, weekly and monthly volumes. It is well understood that volumes vary during the hours of the day, days of the week

Fig. 5 above is a photo-electric counter showing twin light sources together with twin mirror and lens assemblies.

Fig. 6 above is a photo-electric counter showing photo-cells extreme upper and left hand sides of housing together with hourly printing unit and synchronous clock left and amplifier right of centre.

and months of the year though routes in similar localities and conditions develop definite types of pattern. Different classes of traffic also develop their own individual trends and a further important factor is the effect of weather conditions. For these reasons when using sampling methods the number and duration of counts must be based on the accuracy of the information required. In general, where only a limited number of counting hours are available, it is better to carry out very short counts spread throughout the hours of day, days of week and months of year but, using instruments, this is generally not so convenient and manual methods are normally employed for scattered hours or minutes throughout the year. As data is built up conversion factors can be determined for application to other similar routes until complete information is available on all main routes. Peak flows and the distribution of flow rates and the time that these prevail are of importance in design.

The peak flow used in Great Britain by the Ministry of Transport is usually the maximum hour's flow during the seven-day August traffic census. All sorts of factors such as weather, location, congestion, etc. may affect this figure and the Road Research Laboratory have suggested a modification by selecting the highest average flow for a particular hour of day, day of the week, during the highest quarters' flow. This is more satisfactory but on important routes the extra effort required to measure the flow in all hours of the day throughout a year with printing unit counters establishes a still better basis.

Typical American practice for design purposes is to select a certain highest hour of the year, frequently lying between the 30th and 80th, and this highest hour can either be determined by the use of conversion factors if these have been satisfactorily established or by using hourly counters at selected sites in the required locality. If for instance the 50th highest hour has been used and the correct increase in vehicle growth, diverted and generated traffic established for say a 20 year period, 50 hours of overloading would occur at the end of the 20 year period.

PROFILE (*Concluded from page 225*)

found himself in his first big association with engineers, himself designing the layout with its main road through the Team Valley Estate, his interest in problems of communication established. From the long list of his achievements since then, in public and private enterprise, in civic and university building, housing, schools, etc., it is reasonable to single out his association with the firm of W. H. Maunsell and Partners, in the design of the King's Avenue Bridge, the Commonwealth Avenue Bridge and the Central Parkway in Canberra, typical of his endeavour to bring about the re-marriage of architecture and engineering, professionally divorced since Thomas Telford's day. Currently, he is also engaged with Sir Alexander Gibb and Partners on the Ross Spur stretch of the new Midlands-South Wales Motorway, with its bridge over the Severn, illustrated in this journal in June.

Professor at 28

He has still one more professional occupation. Just before and just after the War, he followed Sir Patrick Abercrombie, first as Professor of Civic Design at Liverpool, then of Town Planning at London, the earlier appointment for some reason provoking a third leader in The Times, indignant at a professor only twenty-eight years old.

Even now, just turned fifty-three, he has no donnish air. Slightly built, he is still a young-looking man, with a sartorial sense that gives a touch of elegance even to a soft-collared shirt. A couple of quirks of habit, though, most fitting his donnish role . . . flowing talk, not unlike an informal lecture, and an occasional flicking out of the fingers, as though impatient of a student's slow comprehension.

Amazingly, he finds time for tennis, swimming, walking, even painting, but a principal hobby is the theatre. With absorbing recollection, he recalls designs he and his wife did for the Liverpool Playhouse under William Armstrong. Lovingly, he remembers colours and experimental textural effects.

Key to Success

This absorption, almost as much as his gifts, is, perhaps, a key to his success; though it must also be a liability. He has lived fully every phase of his career—the student years, for instance, when he travelled cheaply, revelling in Europe's architectural treasures. For student argument, late into the night, he is still grateful, as he is for the trust of his first important employers, especially General Appleyard and Sir Hugh Beaver, who didn't laugh at his various projects. In his brief commercial interlude he even taught himself shorthand. Then, as a newly fledged graduate, he and his companions threw themselves into international competitions they were too young and inexperienced to have a hope of winning, but from which they believed they would learn by trying. He recognizes, though, his difficulty in resisting anything he wants to do and the over-conscientiousness that could lead to a break-down. Recently, shocked to realize he was a member of fifty committees, he promptly resigned from a number, seeing that madness lay in imagining anyone could be useful on so many.

Aptly and deservedly, he lives in a Decimus Burton house in the scheme of Nash Terraces round Regents Park. Deservedly, because bombing had left it open to the elements, and he took over the restoration. He had done this for a former home, the smallest house in London, a dairy when Belgravia was still a snipe ground. One wall still bore the legend: 'Purveyor of milk to the Duchess of Cambridge'. It might be hard to decide, as he looks tenderly at his wife's painting of it, whether he is more drawn to bijou picturesqueness or Nash elegance. It is surely significant, though, that he and his wife moved out of the one because of noise, and into the other largely for its view over the park.

R.L.

Next Month's Profile

J. F. A. BAKER

Chief Engineer (Highways)

Ministry of Transport

COURSES IN TRAFFIC ENGINEERING

LAST June we published some particulars of the course available at the Graduate School in Highway and Traffic Engineering at the University of Birmingham, the chair of which is held by Dr. J. Kolbuszewski.

This year's examinations were held at the beginning of June and as a matter of interest we reprint the questions to candidates in the Traffic Engineering paper, five of which had to be answered.

Traffic Engineering

1. (*a*) Write briefly on origin and destination surveys in the study of traffic patterns in urban areas.
(*b*) It is proposed to carry out a route interview survey within an urban area as a basis for the establishment of the design of an inner road. Describe in detail the technique for the collection and analysis of the data.

2. (*a*) Discuss the significant factors in designing the optimum signal settings for an intersection controlled by fixed time traffic signals.
(*b*) Describe, with comments, the principle of vehicle actuated traffic signals paying particular attention to those aspects which overcome any disadvantages of fixed time installations.

3. It is said that 'increasing vehicle ownership is resulting in arterial thrombosis, particularly in central urban areas.' Discuss the validity of this statement and suggest methods of approach by the engineer in the redevelopment and development of towns.

4. (*a*) 'Capacity is of the utmost importance to the design engineer.' Comment on this statement and discuss the factors which have a bearing on capacity.
(*b*) Determine theoretical capacities for speeds of 10, 15, 20, 30 and 40 m.p.h. on a single traffic lane in ideal conditions. State the basis of your assumptions and plot a curve for the values obtained.

5. As an engineer charged with the responsibility of organizing a traffic engineering section in a large city explain the duties and studies which are needed for short and long term improvements to the traffic situation.

6. Write briefly on *two* of the following topics and their relationship to the problem of accidents.
(*a*) Street Lighting.
(*b*) Surface Characteristics.
(*c*) User Behaviour and Characteristics.
(*d*) Education and Enforcement.

7. (*a*) Automatic traffic counters have been used for a period of two years to collect hourly volume data for a particular route. The information is tabulated above (Annual Average Hourly Volume=100%).

Use the data to draw characteristic histograms and cumulative frequency curves for this type of route.
(*b*) If a similar type of neighbouring route is carrying a total of 4,000,000 vehicles in a year, use the curves to find the number of vehicles carried at a rate in excess of 1800 v.p.h. and the number of hours in the year that this rate will be exceeded.
(*c*) Show how a reasonable design volume can be ascertained from the information and explain the significance of the method.

Class Interval Percentage of Annual Average Hourly Volume	*Frequency (f_1) Percentage of Total Annual Traffic*	*Frequency (f_2) Percentage of Total Time in One Year*
0—50	4	10
50—100	9	25
100—150	14	32
150—200	21	20
200—250	19	6
250—300	16	3.5
300—350	9	2.0
350—400	6	1.0
400—450	1	0.35
450—500	1	0.15

8. (*a*) Explain the use of road markings, signs and channelization of grade level intersections.
(*b*) Write briefly on the design of merging, diverging and weaving areas considering some of the important problems of exit and entry ramps in grade separated intersection design. Use sketches, where appropriate, to illustrate your answer and include some mention of modern design standards.

Other papers set covered Materials, Design and Construction, Soil Mechanics and a General paper on Highway Engineering. The last included some Traffic Engineering questions, four of which had to be answered. They were:

Highway Engineering (General)

1. What strikes you as the most significant conclusion to emerge from the study of traffic statistics?

2. Toll roads became a feature of the American scene just after the Second World War. Why?

3. What do you know of the Road Fund? Do receipts in gross from taxes on motors furnish a guide to the expenditure of highway authorities?

4. 'It is idle, in considering the problem of providing for traffic in towns and other badly congested areas, to neglect the contribution which, in the circumstances, might be made by a properly designed system of tolls.' Do you agree?

5. Explain in detail why the Midland Red can charge to London 21s. 3d. return, and the fare by rail (2nd class return) is 42s. 6d. Can the difference be put down mainly (or even at all) to the fact that the bus uses the road free, while the railways carry full responsibility for their track?

6. Is it possible to ascertain the cost of providing roads for different classes of user?

7. What data are needed to compare the value of one scheme of road improvement with another. Can these data be got?

8. Consider the impact of congestion upon costs.

9. What do you understand by the cost/benefit ratio? Is it significant that so many of the benefits from road improvement, particularly those accruing to the drivers of private cars, cannot be precisely evaluated?

The examinations are followed by three months practical field training arranged by the Graduate School and the candidate is subsequently examined on this also and his work assessed accordingly.

Examination Results

OUT of the 18 candidates who sat for the Institution of Highway Engineers Diploma in Traffic Engineering last April, six were successful. This was the first examination to be held in this country devoted wholly to this subject and some of the questions set for candidates were published in *Traffic Engineering and Control* in the June issue.

The successful candidates, all of whom serve with local authorities were:

ARTHUR NEVILLE CROWTHER, B.Sc., A.M.I.C.E., A.M.INST.H.E., (Assistant, Traffic Engineer, Lancashire C.C.). EDWARD RUSSELL EMERY, A.M.I.MUN.E., A.M.INST.H.E., (Senior Assistant Engineer (Traffic), Kent C.C.). JOHN LESLIE VENABLES LOMAS, B.Sc., A.M.I.C.E., A.M.I.MUN.E., M.INST.H.E., (Senior Assistant Engineer, Coventry City). JAMES EDWIN REED, A.M.I.MUN.E., M.INST.H.E., (Deputy County Surveyor, Isle of Wight C.C.). DAVID LOUIS SELBY, A.M.I.MUN.E., A.M.INST.H.E., (Assistant Engineer, Margate Corporation). RODNEY SHEATH, A.M.I.MUN.E., A.M.INST.H.E., (Senior Assistant Engineer, Hertfordshire C.C.), who was also awarded the Graham Bennett Prize of a Silver Medal and Books for the candidate gaining the highest aggregate of marks.

LETTERS to the EDITOR

NEW APPROACH TO ROAD ACCIDENTS

From Brig. R. F. E. Stoney, C.B.E.
Director-General, RoSPA

I READ Mr. Leeming's article, 'New Approach to Road Accidents', in your June issue with the greatest interest. Mr. Leeming is most certainly right to draw attention to the danger of over-stressing the enforcement element in the approach to the road accident problem, which might easily result in our losing sight of the importance of the traffic engineer's vital contribution to road safety.

In according priority to the latter, Mr. Leeming is in fact applying to the road accident situation what RoSPA has been teaching for many years in the industrial safety field and which has been adopted with great success by all progressive managements in their approach to accident investigation.

Briefly, it consists of regarding any works accident as a failure under one or more of the three heads—Design, Supervision and Personal *in that order*. 'Design', covering safe environment, safe equipment and safe system of work, and 'Supervision', are both entirely within management control. Only if no action that could reasonably have been taken under these two heads would have averted the accident is it permitted to record the occurrence in any way as a 'Personal' failure on the part of the employee, even though the latter might through human error have been the major causation factor.

For example, if a worker wearing totally unsuitable footwear suffers a foot injury the immediate management reaction is to enquire, in the case of a fall, into the state of the floor surface and the lighting, or, if it is a punctured wound, what has gone wrong with the 'housekeeping'—that is, failures of Design and Supervision respectively. If, at the enquiry, even a minor causation factor is discovered which, if remedied beforehand by management, would have prevented the accident, that item is dealt with and the appropriate remedy applied elsewhere throughout the works.

The parallel with road accidents is close, the remedies for the three failures being Engineering, Enforcement and Education respectively. Here I feel that Mr. Leeming is in danger of doing himself what he complains about in others. Under his hypothesis, there would seem to be some danger of the pendulum swinging too far in the other direction, allowing the driver to shrug off all responsibility for road safety on to the shoulders of the traffic engineer. By all means let us ensure that traffic engineering is given its full due as a basic remedy for the road accident situation, but do not let us spoil a good case by talking of the 'persecution of the motorist.'

The existing law should be enforced, but not in the indiscriminate hit-and-miss manner which is frequently the case at present. Inevitably among the 10 million licence holders in this country, there is a proportion of selfish and misguided individuals who welcome the least encouragement to flout the law and it would be doing a disservice to road safety to imply, however remotely, that the law on the subject is an ass.

I hope that nothing I have said will be construed as denigrating the valuable and stimulating contribution of Mr. Leeming to the road accident problem. May I therefore conclude by wholeheartedly supporting him in his plea for new machinery for accident investigation designed, as is the case in industry, to uncover all causation factors rather than to find if blame can be placed upon an individual road user.

From J. G. H. Heasman, A.M.I.C.E.
County Surveyor, West Suffolk.

Mr. Leeming in his interesting and thought provoking article poses the question 'Do we really know why accidents happen'?

The mechanical vehicle whilst at rest is harmless. The road, however many bends, reverse crossfalls, slippery surfaces, crossroads and junctions, is in itself equally innocuous. Bring the two together and provided there is no movement there is no danger. Bring in a catalyst in the form of a driver or drivers and the accident potential immediately leaps from zero to infinity.

'Perfect Drivers' with their vehicles always under perfect control could drive on a road with highest accident potential in perfect safety, but, there are regrettably no perfect drivers, nor can the accident potential of all roads be reduced to zero: because all roads cannot be made perfect.

For instance, in his example of cross roads consisting of a minor road crossing a major road, Mr. Leeming suggests that the two main factors causing an accident are (1) error on the part of Drivers A and B, and (ii) the presence of the square cross roads, and he suggests engineering would eliminate the second. Grade separation is the obvious answer, but this is not always possible, this leaves us with a roundabout or a staggered junction, neither of which are 100 per cent accident proof. There are also many crossings of minor roads of equal importance, where neither a roundabout nor a staggered junction would be an economic possibility for many years. Engineering can do much to decrease the accident potential of a road by removing bends, redesigning junctions, improving superelevation, vertical curves, providing non-skid surfaces and on the more heavily trafficked routes dual carriageways. Many of the less heavily trafficked routes will for economic reasons have to continue as single carriageways, together with all the roads of lesser importance.

As to enforcement, the thug and criminal if they are convicted are sent to gaol, and whilst there every effort is made towards their reformation. The driver does not, however, set out with intent to drive carelessly or dangerously, but all the same is fined, disqualified and imprisoned for what, in the majority of cases, amounts to a momentary lapse of judgment, lack of concentration or a mistake, and in many cases because he has never been taught to drive properly.

In some quarters it is suggested that penalties should be greater, but a fine is inflicted on a driver only after he has been involved in an accident and only then may it possibly make him more careful in future.

Disqualification is in essence a concealed fine in that it may affect a driver's livelihood and does he return to the road at the end of his term of disqualification or imprisonment a better or more careful driver? More careful, perhaps, for a short period, but possibly even a worse driver through lack of practice and experience, which may cancel out any increased care.

The so called Driving Test cannot by any stretch of imagination be called a 'Test of Driving', consisting as it does of driving three or four miles accompanied by an examiner over a route which the pupil has travelled several times with his instructor, at a speed not exceeding the 30 m.p.h., and answering a few questions on the Highway Code. Then, provided the pupil stops at halt signs and traffic lights, signals correctly, can turn, reverse, park the car, and steer reasonably well, he is passed. The pupil need not have been driving for many hours and can then drive unaccompanied a car capable of 100 to 140 m.p.h. The same applies to motorcycles where a young lad can pass his test on a light weight machine and having done so go out on a heavy, high powered one.

What is the alternative? I suggest that the present test be retained, but that learner drivers are only passed as proficient to handle a vehicle by qualified instructors from a registered Driving School. The learner would then

(*Continued on next page*)

BOOK REVIEW . . .

Garages and Service Stations, by Rolph Vahlefeld and Friederich Jacques, Leonard Hill, 63s. 0d.

This is a remarkable survey of how storage accommodation can be provided for the growing motor car 'park', to use a continental phrase, and how needs can be adequately met at the same time as full regard is paid to the demands of architecture and aesthetics. It is a most comprehensive study, containing not only an incredible amount of technical detail both in regard to construction, lay-out and design—from garage doors and ventilation to lifting gear and pits, from lock-ups to multi-storey garages—but all is attractively presented, finely printed, well produced and generously illustrated. Lest such praise should sound too fulsome, let it be added that the work combines both the merits and defects of Germanic thoroughness. The detail, though at times overwhelming, can but evoke admiration, even if the generalizations sometimes tend towards the obvious and are often no more than commonsense, if not platitudes. Nevertheless, none concerned with providing for the needs of the motorist, whether domestic or public garages, service station or rest-house, garage for public service vehicles or car park in the open, driver hostels or car valetting service, can afford to ignore this compilation of the best that has been devised in this growingly important field at home and abroad up to the time this book was originally prepared. That was in 1953 when it was published in Germany, but it has now been revised for the English-reading public and suffers little from the fact that it was written for a set of conditions applying in one country which is not necessarily found in others. However, appropriate sections have been added, including a concise summary of relevant British legislation, and by and large motorists' needs are similar in all motorized countries.

One of the most pleasing features of the book, and one which it is to be hoped will have its effect upon the future design and construction of garages and filling stations here, is its demonstration that poor design and unsightliness are not a necessary adjunct of the motorized era, as too often appears to be the case, and is too readily taken for granted by those who provide service stations and car parks. The authors would have served the cause of good design even better if the excellent examples given of the best that is so lavishly illustrated, were contrasted with more ordinary and common structures that are too much with us.

All those who are responsible for helping us to live with the motor car, whether they be town planners, architects, city, borough, highway or traffic engineers, should be given the opportunity that this book provides of learning the lessons that the experience set out in this comprehensive survey has to teach.

Letters—(*continued*)

be permitted to drive for a further year as a provisional driver carrying a 'P' plate in place of the 'L' plate and accompanied by a qualified driver. He would have to drive for a minimum number of hours, and, at the end of that period, would be required to pass an advanced test taken by a Ministry of Transport examiner, over at least 100 miles of urban and rural roads. It would be impossible to put all drivers at present qualified through such a test, but if all learner drivers were tested in this manner, the quality of driving would undoubtedly improve.

A similar test could, however, be applied to all drivers found guilty of careless or dangerous driving in lieu of or in combination with the present system of fines, imprisonment and disqualification. Should a driver fail to pass this advanced test, he would be given a further six months and, if he failed again, would, apart from exceptional circumstances, be disqualified for life.

It may be argued that such a test as proposed would require many more examiners and would be expensive, but would it not be worth while? Such a scheme could not fail to improve the standard of driving and thus contribute to the reduction of accidents.

Pedestrian Precincts

SIR—I commend you on printing articles by Architects and Planners on Traffic Circulation in Towns. It shows some of the muddled thinking with which the Highway Engineer has to contend at the present time.

The idea of pedestrian precincts is probably basically sound, but there is no doubt that considerable research is required before they should be fully accepted as good traffic engineering principle. In this town there are already many and peculiar problems because a partial segregation of traffic has been imposed. It seems to be largely overlooked that if you close extensive areas of frontage to traffic, it simply increases the volume using circulatory and peripheral routes. It seems to me vital that we should carry out extensive experiments on traffic use in the few existing examples of pedestrian precincts before accepting the current planning thought that this is the panacea for all our central area development proposals.

P. S. CHESTER
Harlow.

Traffic Data

SIR—The problem of the lack of adequate traffic data, so ably discussed by Mr. Conrad Andren in your first issue, is not confined to London. There is a vital need for what Mr. Andren calls 'a factual analysis of costs and benefits to the community of alternative long-term schemes' all over the country.

It is putting the cart before the horse to suggest major schemes without full knowledge either of what is required or of how these schemes will benefit the community. 'Half-informed comment' may waste everybody's time, but half-informed construction wastes everybody's money as well.

Patrick Thursfield
Secretary, Road & Rail Association.

CONFERENCES

THE Fifth International Traffic Study week on Traffic Engineering organized by the World Touring and Automobile Association will be held at Nice starting on September 26 and will be followed by the International Road Safety Congress, from October 3 to 5. Details of the programmes were given in the July issue of *Traffic Engineering and Control*, and further particulars can be obtained from the organizers.

Canadian Roads Conference

Christopher Brunner, Vice-President of the British Road Federation, and Director of Shell-Mex B.P., is one of the chief speakers at this year's annual conference of the Canadian Good Roads Association to be held at Toronto October 17 to 23. The first plenary session will be held in the evening of October 17 when there will be a three-hour symposium covering the work done during the year by the Special Committee on Pavement Design and Evaluation. The afternoons of Tuesday, Wednesday and Thursday will be devoted to technical sessions when 28 papers will be presented—five on soils and materials; three on economics, finance and administration; five on construction and maintenance; five on municipal roads and streets; five on planning and design; five on safety education. The new bridges and structures committee, formed at last year's convention, will take over on Wednesday evening and plans to present three important papers. The traffic and operations committee has assigned three papers for presentation on Thursday morning.

PARKING

THE Institution of Municipal Engineers is to hold a day's conference on 'The Problem of Car Parking' on October 6. The Joint Parliamentary Secretary, Mr. John Hay, M.P., will open the Conference and deliver the first address. The Conference will be held at the Central Hall, Westminster. The provisional programme is as follows:

10.00 a.m. **Official Opening** by Mr. John Hay, M.P., Parliamentary Secretary, Ministry of Transport.

10.30 a.m. Introduction by the President for 1960/61 (Mr. A. S. Hamilton, B.Sc., M.I.Mun.E., M.I.C.E., A.R.I.B.A., F.R.S.H., Borough Engineer, Blackpool).

10.45 a.m. Mr. J. L. Beckett, M.I.Mun.E., City Surveyor, Leicester, on **'Traffic and the Parking Problem'**

Mr. A. W. Hogg, B.Sc., M.I.Mun.E., A.M.I.C.E., City Engineer, Westminster, on **'Control of Street Parking'**

2.15 p.m. Mr. Granville Berry, M.I.Mun.E., M.I.C.E., City Engineer and Surveyor, Coventry, on **'Roof-Top Parking and Mechanical Parking'**

Mr. D. J. Howe, M.I.Mun.E., M.I.C.E., Borough Engineer and Surveyor, Brighton, and Mr. E. O. Baxter, M.Eng., M.I.Mun.E., A.M.I.C.E., Borough Engineer, Hastings, on **'Parking Problems at Sea-Side Towns'**

TWO DESIGNS FOR PARKING

The chief handicap to the provision of off-street parking in multi-storey garages is the original cost per car space which, together with overheads, frequently puts economic charges beyond what the motorist is willing to pay. The greatest need is, therefore, to reduce both construction and operation costs. A contribution to this end is the Streamline Parking Garage which is designed on the principle of a continuous concrete roadway to enable cars entering and leaving to travel in one direction only. Its designers and constructors claim that this is the simplest and most effective car park system yet devised, as the maximum amount of space is available for parking and overheads are at the minimum, because only a single attendant is required to marshal the drivers of 750 cars up the ramp. Drivers themselves then leave their cars in the first available space. Should the garage be full, they can drive the length of the 'roadway', and return to the starting point where space is provided to wait for a vacancy.

The floors are arranged in two spirals, interleaved one with the other, one floor for ascent and one for descent. All traffic is one-way on one continuous carriageway from entrance to exit. There is no crossing of traffic. To guard against the driver being confused or losing his way, there is only one road along which he is directed by arrows on a thick red or blue line from a single control point, until he finds a vacant space. He then parks and leaves by stairs or lift, never walking more than 40 yards. The single attendant is stationed at the entrance and has full control of every car or pedestrian entering or leaving, and knows immediately that the park is full when one car returns. The operation is similar to that of a toll gate, and is equally simple and efficient.

With a gradient of 1 in 28, and a depth between floors of about 8 feet, the Streamline Parking Garage would be 248 feet long and 104 feet wide. With four circuits above street level, giving a distance of 700 yards, and two below giving 350 yards, the garage would accommodate 684 vehicles. Each additional floor provides an extra 112 places, and by increasing the gradients to 1 in 20 the building length can be reduced to 152 feet. A smaller structure could also be erected. The contractors claim that this multi-storey car park can be constructed in a year.

The Streamline system, using a rectangular site with maximum density customer parking, offers an efficient and economic method, and recent figures given in a paper read to the Institution of Civil Engineers give the efficiency as 61.5 per cent, almost 10 per cent higher than others referred to there. Such a garage for a minimum of 600 cars can be built for under £200 per car space, exclusive of land and planning, which is required under certain conditions by fire prevention authorities. It appears to be suitable for large department stores, since communicating doors can open into the store from the ramp wherever floor and ramp coincide, and for factories, local authorities and airports when it is desirable to extend car parking facilities but to use the same or even less ground space.

Builders and promoters are Wilson, Lovatt & Sons, Ltd.; Architects T. Elvet Llewellyn and Lawford Gower; the structural design was prepared by British Reinforced Concrete Engineering Co. Ltd.

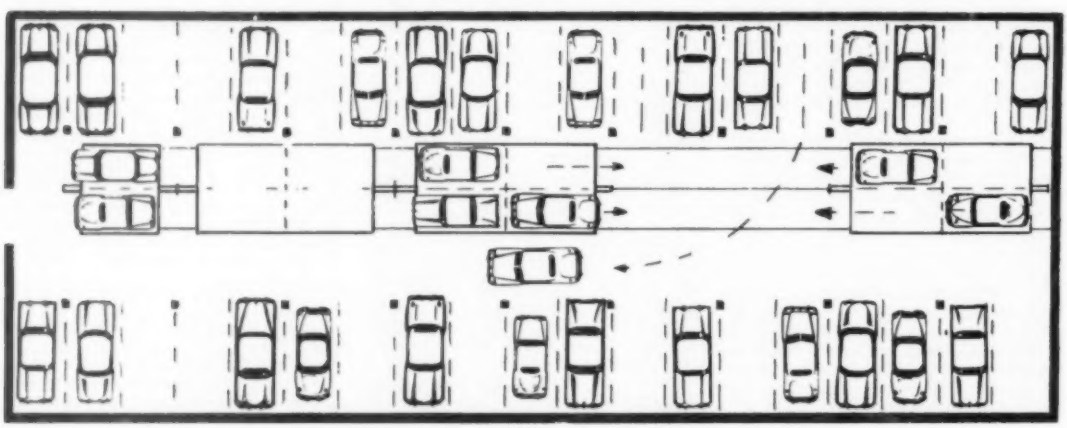
For further details reference No. 34.

Extraspace Garage Plates

August 15 is the date fixed for a demonstration, to be held in Malmö, Sweden, of a mechanical parking system designed to increase the capacity of future ramp type garages, single floor parking areas or those already in existence. This system is to be marketed in this country by Extraspace Garage Plates, a new company formed specially for the development and presentation of this Swedish invention. The system, known in Sweden as the Plymoth Garage Plate Type A, consists basically of a number of movable platforms set very close to the flooring of the gangways between parking areas. (The plan shown on this page illustrates the layout of normal parking rows with the platforms in position.) These platforms or plates are made entirely of iron and have a stable frame design. They are set on wheels to a height of 2¾ inches from the floor level and the wheels run on a simple rail, which is easily incorporated into the flooring of existing garages or laid into the concrete of a new project. The Extraspace plates are made with sides that slope outwards and downwards, to make it very easy to manoeuvre a car on or off. The motive power, to move the plates out of the way of any vehicle parked directly behind or to the side, is supplied by an electric motor or by compressed air: in the case of an emergency, such as complete failure of mains power supply or a breakdown in the compressed air mechanism, the plates can be disconnected and moved by hand. The easy running of the ball-bearing fitted wheels ensures that little manual effort is required to move a fully loaded platform a distance sufficient to clear the way for a baulked car. The manufacturers claim that by installing this equipment, which is available to suit any shape or size of garage or width of driving gangway, an increase of 20 to 40 per cent of the capacity can be obtained at low cost.

For further details reference No. 35.

The layout of a garage with the Extraspace plates in position.



TRAFFIC CONTROL DEVICES

TV-EQUIPMENT as a reliable means of traffic-scouting proved its value during the Hanover Fair in 1959, and again in 1960 in both Hanover and Hamburg. The equipment, which was used for the first time in such a comprehensive way, was manufactured and installed by TEKADE and FGF of Nürnberg, Germany. Responsible traffic authorities were able to follow the movement of as many as 75,000 cars in one morning alone in the direction of Hanover fair-grounds, and by receiving instant information, concerning the great volume of traffic, the traffic-control headquarters could initiate measures in time to maintain a constant traffic flow on the main roads towards the fair-grounds. Round the Hamburg-Elbe bridges the traffic situation has grown very critical recently. Traffic experts of Hamburg have been forced to install a special traffic control headquarters for this area to supervise and control the large volume of traffic. Here again it was necessary to get reliable and objective information for traffic scouting, and the chief of the Hamburg Police decided to place the most modern means of traffic-scouting equipment at the disposal of the Hamburg special control squad.

Technical Composition

The TV-equipment used in Hanover and Hamburg consisted of several closed-circuit systems, the cameras of which were used to pick up pictures of the traffic centres in the city areas. The cameras were housed in a weather-proof cylinder-shaped case, aluminium-moulded, and had a sun-protector and additional thermo-relays for the maintenance of definite temperature limits in the interior of the housing. Each camera had a pan and tilt unit, which could be remote-controlled, and allowed turning of the cameras by 350° and tilting by ± 90°. The necessary impulse generators and picture amplifiers were installed in a modulator unit near the position of the camera. Radio-link equipment was used to transmit the signals from the camera to the monitor. This radio-link equipment operated in the 7,000 mc. range and used parabolic mirrors or horn radiators as antennae. All receiver antennae were mounted near the traffic control centre on top of a high building. For the control and the adjustment of the picture signals, the individual TV-cameras were equipped with control monitors with screens of 17 cm. diagonal and a local control unit. This equipment was connected to the modulator units, and allowed on-the-spot continuous maintenance and control of the cameras. The traffic control centre in Hanover contained a total of seven TV-receivers (monitors). Each of these was attached to one of the camera positions in the area to be controlled, and were linked with these positions through the radio-link systems, consisting of transmitter with antenna equipment and receiver with parabolic mirror. The cameras at the individual positions were not rigidly fixed. It was possible to turn and to tilt the cameras by means of a new remote control equipment, and although all the cameras had an automatic light value adjuster, it was necessary to control the lenses remotely as well as the focus.

Particularly interesting from an electronic point of view was the TEKADE remote-control system. All control signals were converted over a signal-converter into voice frequency signals. These were subsequently transmitted over a service channel to remote-control receivers at the position of the cameras, where the voice frequency signals were analysed and converted into control impulses. The remote-control receivers subsequently fed the control impulses into the pan/tilt unit and/or the lens control unit. The remote control transmitters and receivers were equipped exclusively with TEKADE semi-conductor elements and resonance relays. All control impulses were transmitted through service channels of the radio link equipment, carrier-frequency equipment, VHF radio telephone units or two-wire telephone lines with equal reliability. The cameras were remotely controlled by an operating unit in the traffic headquarters. This control unit had several press buttons by which it was possible to select whichever of the cameras it was required to control at a time. It was thus possible to survey individually all important crossings in the area around the camera.

Finally we should like to mention that the whole TV-system used for traffic control was not a special version for this particular purpose. The TV systems were taken out of normal series production.

For further details reference No. 36.

The TEKADE remote control system in use at Headquarters.

MINISTRY OF TRANSPORT NEWS

IN a recent speech the Minister of Transport said . . .

'In London the existence of the Thames means that major road schemes must be matched by suitable river crossings. The expense will be enormous and it is imperative to site both roads and bridges in the correct place. To do that we need more facts about London's traffic requirements. There has never been an overall origin and destination survey of London traffic—and I want to establish the pattern of traffic in and out of London on all major radial roads plus the pattern of movement in the built up area.

Then we shall have a scientific basis for a pattern of ring roads or for a series of tangential roads. I hope it will be possible to start on this sort of survey before the end of the year. For too long we have neglected the scientific studies and analyses which can be made by properly trained and qualified traffic engineers. In the meantime I am examining all the suggestions for ring roads and bridges sent to me and I am especially interested to examine the statistic foundation on which the suggestions are based.'

'Editorial Opinion' in this journal makes a reference to this speech on page 193.

Holborn Parking Meter Scheme

An Order (The Parking Places (Holborn) (No. 1) Order, 1960) authorizing the installation of 684 parking meters in the north-west corner of the Borough of Holborn has recently been made. The area is bounded by, but excludes, New Oxford Street, Bloomsbury Way, Southampton Row, Woburn Place, Tavistock Square, Gordon Square, Torrington Place and Tottenham Court Road. The meters and their ancillary 'No Waiting' restrictions, which together constitute a controlled parking zone, will come into operation on October 3, 1960.

The application by the Holborn Borough Council for the setting up of a controlled parking zone was the subject of a public inquiry held on behalf of the London and Home Counties Traffic Advisory Committee from September 30 to October 2, 1959. The report of the public inquiry, which was endorsed by the Advisory Committee and accepted by the Minister, was that the scheme should proceed subject to certain modifications, the chief of which was that no meters be installed south of Bloomsbury Way or east of Woburn Place for the time being. The Holborn scheme is similar to the controlled parking schemes now operating in Westminster and St. Marylebone except that parking on Saturday mornings, although still confined to meters, will be free of charge or time limit, and in certain parking places goods vehicles will not be allowed to park. A more detailed announcement will be made, for the benefit of motorists in the zone, shortly before the scheme comes into operation.

Reconstruction of Rickmansworth Bridge, Middlesex

The Ministry of Transport has made a grant of £75,375 to the Middlesex County Council towards their share of the cost of reconstructing the bridge which carries the Metropolitan line railway over Rickmansworth Road (A404). The present bridge is an old brick arch structure with a carriageway width of only 20 ft. and a single 5 ft. wide footway on the north side. The London Transport Executive are rebuilding the bridge to take duplicate railway tracks and the Council have taken the opportunity of joining in the scheme to provide two 20 ft. carriageways with a 4 ft. central reserve and 8 ft. wide footways on either side. The headroom for vehicles under the bridge will be increased from 11 ft. 6 in. to 16 ft. 6 in., and the approaches to the bridge will be improved from the junction with The Drive to the junction with Chestnut Avenue.

Port Talbot By-Pass

A contract has been let to The Cleveland Bridge and Engineering Company at a cost of £329,216, for the first stage of the scheme to by-pass Port Talbot, Glamorgan, on the London-Fishguard Trunk Road. This contract covers the widening of the existing road between Baglan and Briton Ferry, which has to carry a heavy volume of traffic and is consequently very congested. It will be converted into a dual 24 ft. carriageway with 9 ft. cycle tracks and 6 ft. footways. The scheme involves the importation of 15,000 cu. yd. of filling material to build up levels, extensive alteration to public utility services, diversion of the Baglan Brook and erection of a mass concrete retaining wall alongside the railway at Baglan. At the roundabout at Briton Ferry the road will connect with the recently completed Neath By-Pass, and a new roundabout will be constructed at Baglan where the new by-pass round the town of Port Talbot will later begin. The work on this scheme is expected to take about 14 months.

Modern Road for National Trust Area

A trunk road passing through one of the most beautiful areas in the Midlands is to be widened. It will provide a modern link between the northern end of the Bristol-Birmingham Motorway at Lydiate Ash and the outskirts of Birmingham and have a special 5 ft. wide footpath for walkers. The first stage of the work on A38, from Spring Pools to Chadwick Reservoir, will be undertaken by Messrs. A. Monk & Co., as an extension of work they are carrying out on the Bristol-Birmingham Motorway, and it is expected that the work will be finished by June, 1961 at an estimated cost of about £125,000.

Between Spring Pools and the Reservoir, a distance of about two-thirds of a mile, the A38 passes up the southern slopes of the Lickey Hills through a National Trust area of great natural beauty. The old twisting three lane road is to be replaced by modern 24 ft. dual carriageways with a 10 ft. wide central reserve and 10 ft. wide outer verges. There will be two large laybys, commanding wide views over the Worcestershire plain and the Malvern Hills, midway between Spring Pools and the Reservoir, and an underpass will be built to provide a crossing for farm traffic.

New Traffic Signs

Twin flashing red lights, with the word 'Stop' on each lens, are to be installed at certain railway level crossings to warn drivers of road vehicles when a train is approaching. The lights begin to flash alternately (each lamp at a rate of 54-66 per minute), as a train approaches the crossing and before the barriers or gates—if there are any—begin to fall or close. As soon as they begin, road traffic must stop immediately. They continue flashing until the train has passed and the barriers or gates start to rise or open. This flashing signal is intended mainly for use at crossings with lifting barriers, but it may also be used at some gated crossings and, on minor roads, at crossings without barriers, gates, or attendants. All crossings with lifting half barriers operated automatically by trains will be equipped in this way, and it may also be used at other places where there is an intermittent need for traffic control, such as opening bridges, ferry landing stages, and roads near airfields. At level crossings where there are to be train-operated half barriers, the timing of the protective arrangements is such that the barriers are lowered about five seconds before the fastest train can reach the crossing, thus reducing delay to road traffic to a minimum and a driver has no cause to endanger his life by disobeying the signals and zig-zagging past the half-barriers. On a double-track line, there will also be an indicator which will read, when illuminated, 'SECOND TRAIN COMING', and indicate that the barriers remain lowered because another train is approaching from the opposite direction. An additional warning at certain crossings may be provided by a two-tone gong. Open level crossings will be marked by a distinctive symbol in the form of a white St. Andrew's Cross on a red ground, which will accord with European practice, and the symbol will be mounted above the sign 'Trains Cross Here', or the flashing lamps where these are to be used. As an extra precaution, highway authorities may use distance markers at the approach to a level crossing of any kind which is not clearly visible to drivers on the road. The first of these, consisting of three diagonal red bands on a white ground, will be erected close to the usual advance sign (the ordinary 'Level Crossing' or 'Crossing—No Gates' signs); the second and third will be spaced at equal intervals and will have two bands and one band respectively.

(*Concluded on page* 237)

INDUSTRIAL NEWS AND INFORMATION . . .

THE David Brown Corporation Ltd., have separated the tractor, agricultural machinery and automobile sides of their business from the gear, foundry and tool operations. A new company, David Brown Tractors, Ltd., will take over the tractor division of David Brown Industries Ltd., and will become the parent company of the tractor group; Aston Martin Lagonda, Ltd., will take over the automobile division and will become the parent company of the automobile group; and David Brown Industries, Ltd., after the changes set out above, will be the principal operating company of the gear, foundry and tool division. Sale of the group's products will continue to be made through the David Brown Corporation (Sales), Ltd.

International Harvester

The International Harvester Company of Great Britain announce production of a new crawler tractor, the BTD-8 (80 Series). The main features of this new product are claimed by the manufacturers to be an ideal ratio of power to weight, balanced construction, operator comfort and economical price. The BTD-8 has the specially designed BD-281 engine which develops 60 brake horsepower at a rated governed speed of 1,600 r.p.m. Maximum torque developed is 225 lb./ft. at 1,100 r.p.m. A choice of two transmissions is available, one with four forward speeds and two reverse and the other with five forward and one reverse speed. The five speed gearbox gives a speed range of 1.8 m.p.h. to 5.4 m.p.h. and 2.1 m.p.h. in reverse and is the more usually required transmission.

A new feature in this tractor's transmission is the 30 degree angled, spiral bevel gears, which give extra gear mesh and greater strength to this very vital component. A flexible coupling in the drive line absorbs shock loads from the track sprockets and protects the transmission. The steering is by way of single coil, multi-plate clutches with new sintered metal facings. Overall weight of the BTD-8 is 10,600 lb. and the basic price of this piece of equipment is quoted as £2,150, ex works.

For further details reference No. 39.

New Jointing Material

The photograph above shows a small part of the new Sittingbourne Road interchange bridge on the Maidstone By-Pass, where Richard Costain Ltd. used a new expansion joint filler. On this section a new closed-cell, resilient filler called X1004 was used in the following way. It was cut on the site from sheets 36 in. by 36 in. and ½ in. thick to a width of 18 in. This was then laid on edge to an overall thickness of 2 in. To simplify the exact positioning of the material, small concrete chips were wedged between the reinforcing steels and the face of the X1004, which was thus securely in position at a uniform depth of 2 in. below the road surface. The concrete was then laid in the normal way. X1004 is the only closed-cell resilient jointing material, which is non-absorbent and waterproof and conforms to every movement of the adjoining sections. It is supplied to various width, thickness and length to suit requirements.

For further details reference No. 37.

The exact positioning of the X1004 filler.

Diesel Tractor

A new version of the Muskeg 'Bombardier' tractor is now on the market with a Parkins type Six 305 (1), six cylinder, water-cooled diesel engine as its power plant. The Muskeg tractor is of Canadian origin and is produced with a single-operator cab and twin double rubber tracks reinforced with steel cable. Each track has 144 heavily profiled links running on eight pneumatic tyred wheels and is driven by special reinforced rubber gear wheels. The braking system, which operates directly on the differential, is in the form of two separate brake bands. One very interesting feature of this tractor is that the chassis is completely watertight as high as platform level.

For further details reference No. 38.

The 'Kerbmaster'

A tool for manhandling kerbs is available from Edward Benton & Co. This tool, the 'Kerbmaster' enables two men to handle a 3 ft. kerb, with safety and speed, by means of a toggle action putting pressure on two end-plates. As long as the handles at each end are held firm, the kerb cannot be dropped. Release from the tool's grip is automatic. Safe, accurate and speedy manipulation of full sized kerbs is claimed.

For further details reference No. 40.

A New Concrete Mixer

Winget Limited are introducing a new reversing-drum, non-tilt mixer giving an output of half a cubic yard at a discharge height of 4 ft. 6 in. The hopper has an angle of 55°, and is moved under hydraulic power. All the control levers can be grouped on either side of the machine, enabling one operator to work two mixers at the same time. This new machine is powered by either a diesel or and electric motor.

For further details reference No. 41.

Please use the prepaid cards for the Reader Information Service. For further details of items mentioned in this journal, complete and return the card to us.

The 'Universal' Parking Meter

A new parking system has been announced by the Universal Parking Meter Co. Ltd., which will do away with the rows of kerbside meters, now becoming a familiar, and perhaps not entirely welcome, sight in many streets in London. Two of the major arguments against this type of parking restriction—the ugliness of the installations and the necessary averaging of vehicle sizes—are eliminated by this new meter, of which only one is required for a number of parking spaces.

The meter consists of a coin-operated ticket machine, which issues a small label for attaching to the windscreen of the parked vehicle. This ticket has a gummed edge, making it a simple matter to stick it in a prominent position on the windscreen, and shows the names of the controlling authority, the location or name of the carpark, week number from 1 to 52 and the day, hour and minute of expiry of issue. These figures are printed in a size that can easily be read from a convenient distance. The meter includes an accurate clock which is supplied with either an electric or spring driven movement, and to facilitate the checking of receipts against issues, all tickets are numbered consecutively. To work the meter the motorist inserts a coin, turns a small knob on the face of the mechanism and tears off the perforated ticket which is extruded from an aperture near the coin slot. One meter is sufficient for a large number of parking spaces—a vast saving in capital and installation costs and the system is even available on a rental basis, which means a substantial income for the authorities with no capital outlay at all. With this system it is impossible for one car to follow another into a metered space and avoid paying because the previous occupier has already paid for more time than was required; the tickets issued by the Universal Meter remain with the car and time must be bought by every motorist who subsequently parks in the same space, a fact which is more important than many people are inclined to think.

For further details reference No. 42.

Loader-Digger Combine

Merton Engineering Co. Ltd. announce the introduction of a combined loader-digger, based on the Merton Frontloader 59 and the Sherman Panther power digger, to be called the Merton Sherman Universal. When the digger is not required it can be folded up almost to within the overall length of the standard Frontloader 59. In this position the whole length of the new machine is only 17 ft. and the makers claim that, because of this compact size, the digger need never be dismounted, which means that the machine can be converted from one use to the other in a very short time. Raising and loading the digger is a simple, one-man operation. A remote control lever on the outside of the machine raises the loader booms. Two tie bars are inserted between digger and loader rams and the locking pins are removed, allowing the loader booms to be lowered and the digger to swing down into its operational position. The locking pins are then replaced and a small lever controls the hydraulic by-pass. The hydraulic stabilizers on this digger are individually controlled, which means that the machine can be set up dead level on uneven or sloping ground. An operating pressure of 2,000 lb. p.s.i. and a special multiple control valve give the digger a full operating cycle of 15 to 20 seconds and the makers claim an output of 25 to 70 cubic yards per hour, depending on the bucket size used.

The dimensions of the Merton Sherman Universal are:—
Loader—maximum 'loadover' height, 12 ft. 9 in.; clear discharge height (under tipped bucket) 10 ft. 8 in. maximum reach, 4 ft. 10 in. (at 6 ft. discharge height); reach at maximum discharge, 2 ft.; discharge angle at maximum height, 43 degrees; crown angle at ground level, 45 degrees.
Digger:—depth of dig, 12 ft.; reach, 18 ft. 1 in. (rearward) or 11 ft. 4 in. (at 90 degrees to machine, measured from side of rear tyre); bucket clearance height, 9 ft. 2 in.; clear discharge height, 8 ft. 8 in.; overall height (travel position), 10 ft. 8 in.; overall width (travel position), 6 ft. 6 in.; overall weight, 6 tons 5 cwt.

For further details reference No. 43.

Aveling Barford Compactor

A triple plate, vibrating compactor is now available from Aveling Barford Ltd. as a rear mounted attachment for their road rollers type GC and GD. On the attachment for GD rollers each of the three vibrating plates has a ground contact area of 388 sq. in. (2,503 sq. cm.) and has a deadweight of 430 lb. (195 kg.). On the GC rollers the plates are slightly smaller as the rolling width which they have to cover is less. Two contra-rotating electrically driven vibrators are fixed to each plate, together producing a vertically acting centrifugal force of 500 lb. (227 kg.) per plate, when rotating at their maximum speed of 3,000 r.p.m.

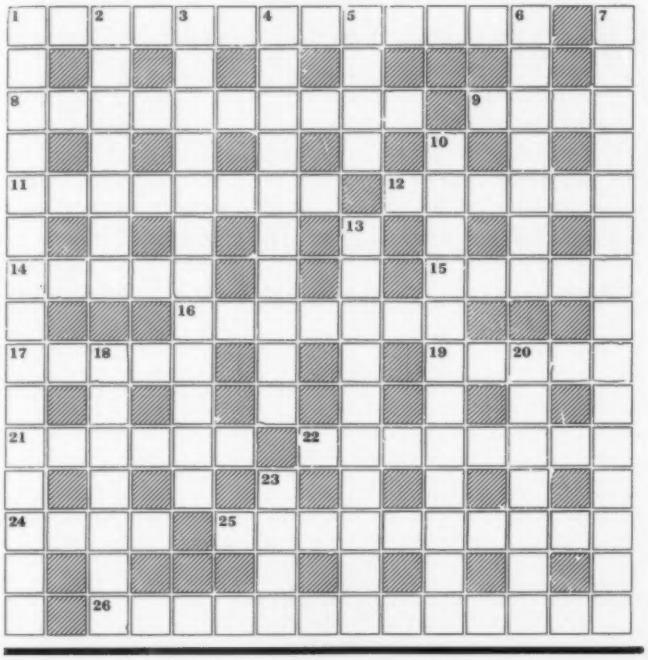
The vibrators are driven by an 8-kVA. alternating current generator which is directly coupled to a Petter air-cooled diesel engine. Engine and generator are mounted on a sub-frame, transversely fitted to the back end of the roller. The vibrating plates are raised and lowered between working and travelling positions by the same rams as are used to control the hydraulic scarifier. But these rams do not play any part in the compacting operation of the attachment—contact between plates and ground being maintained solely by weight of the plates.

For further details reference No. 44.

The Aveling Barford compactor.

TRAFFIC ENGINEERING CROSSWORD NO. 2 by YEO

This crossword is designed for the exercise of the skill of Highway, Municipal and Traffic Engineers and other readers, inasmuch as among the clues and their solutions will be found a number of Traffic Engineering terms which are defined in VOCABULARY OF TRAFFIC ENGINEERING TERMS published for *Traffic Engineering and Control* by Printerhall Ltd., and a copy of which is sent free to all subscribers to this journal.



Across

1. A complete and systematic course. (13)
8. Sidelight. (10)
9. Short and erect. (4)
11. A degree in cloth by the sea. (3, 5)
12. Pharoah. (6)
14. What a donor gives to music. (5)
15. Lord and subject. (5)
16. Eric's progress. (7)
17. Little politician who got into the top class. (5)
19. Illuminated roundabout way. (5)
21. Greek satrap. (6)
22. Musical speaker at No. 10? (8)
24. It's crew were fleeced. (4)
25. I'm stuffy but it doesn't matter. (10)
26. Reversing badly. (13)

Down

1. When does a crocodile cross the road? (10, 5)
2. 'L' (anag.) (7)
3. Pertaining to half of 'O' and 'D'. (12)
4. Start up. (10)
5. Far from running well. (4)
6. Halter? (7)
7. It leads away from cross purposes. (12, 3)
10. Usually on the lower case. (5, 7)
13. Bucolic ballad? (7, 3)
18. No fraction. (7)
20. French Benedick hides cash. (7)
23. Short shot. (4)

Solution to Crossword No. 1

■	E	R	N	E	S	T	■	D	A	V	I	E	S	■
S	■	E	■	S	■	O	■	A	■	I	■	X	■	E
I	N	S	E	T	■	M	I	T	I	G	A	T	O	R
N	■	E	■	E	■	B	■	U	■	I	■	R	■	N
G	U	T	T	E	R	■	■	M	I	L	D	A	L	E
L	■	T	■	M	■	A	■	L	■	A	■	■	■	S
E	E	L	S	■	A	S	S	I	G	N	M	E	N	T
P	■	E	■	S	■	T	■	N	■	T	■	M	■	M
U	N	D	E	T	E	R	R	E	D	■	L	E	D	A
R	■	■	■	R	■	I	■	S	■	C	■	R	■	R
P	L	A	T	O	O	N	■	■	T	H	E	G	A	P
O	■	R	■	P	■	G	■	I	■	A	■	E	■	L
S	L	E	E	P	L	E	S	S	■	S	I	N	G	E
E	■	N	■	E	■	N	■	I	■	E	■	C	■	S
■	B	A	N	D	I	T	■	S	T	R	E	E	T	■

VOCABULARY OF TRAFFIC ENGINEERING TERMS

Since many requests are being received for the 'Vocabulary of Traffic Engineering Terms' published by Printerhall Ltd. for *Traffic Engineering and Control*, for free distribution to subscribers to *Traffic Engineering and Control*, it has been decided to make copies generally available at 2/6d. a copy, post free. The vocabulary consists of several hundred terms internationally accepted for use by traffic engineers based on definitions taken from the vocabulary prepared by the World Touring and Automobile Organization (O.T.A.) and the Permanent International Association of Road Congresses. Requests for copies should be sent, with remittance, to the Circulation Manager, Traffic Engineering and Control, 34/40 Ludgate Hill, London, E.C.4.

MINISTRY OF TRANSPORT NEWS (*Concluded from page* 234)

Police Signs

Previous regulations allowed the Police to use signs, but did not permit them to be reflectorized. This has now been amended and two new signs have been introduced to meet the need, particularly at night, for some means of telling a driver to stop or slow down as, for example, he approaches the scene of an accident. The signs, which have a reflectorized border, lettering and underline, will read

POLICE	POLICE
STOP	**SLOW**

and be made up of white lettering on a blue background with red border.

A new type of beacon which flashes more rapidly may now be used by the Police as an alternative to the existing type. This is because a considerable number of these signs have been damaged by vehicles—no less than 183 in 1957 alone—and there is reason to believe that the low flashing rate may have contributed to the failure of drivers to see the signs until too late. Existing signs are mounted on structures with alternate black and white bands to indicate, for example, that a road is temporarily out of use. Former Regulations required beacons to flash not less than 50 or more than 70 times a minute; the new Regulations legalize a maximum dark period between flashes not exceeding 0.6 second.

'Halt' and 'Slow'

Investigations by the Road Research Laboratory showed that 'Halt at Major Road Ahead' signs were more generally respected when the word 'Halt' was also painted on the carriageway. This carriageway marking is therefore prescribed for use in conjunction with the roadside 'Halt' sign, but its absence will not invalidate the existing signs. New regulations require all 'Slow Major Road Ahead' signs to be illuminated, either by direct lighting or by reflectors or reflecting material, in the same way as 'Halt' signs are already illuminated. Two years grace is allowed for carrying out this requirement.

Copies of the new regulations may be obtained from H.M. Stationery Office.

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